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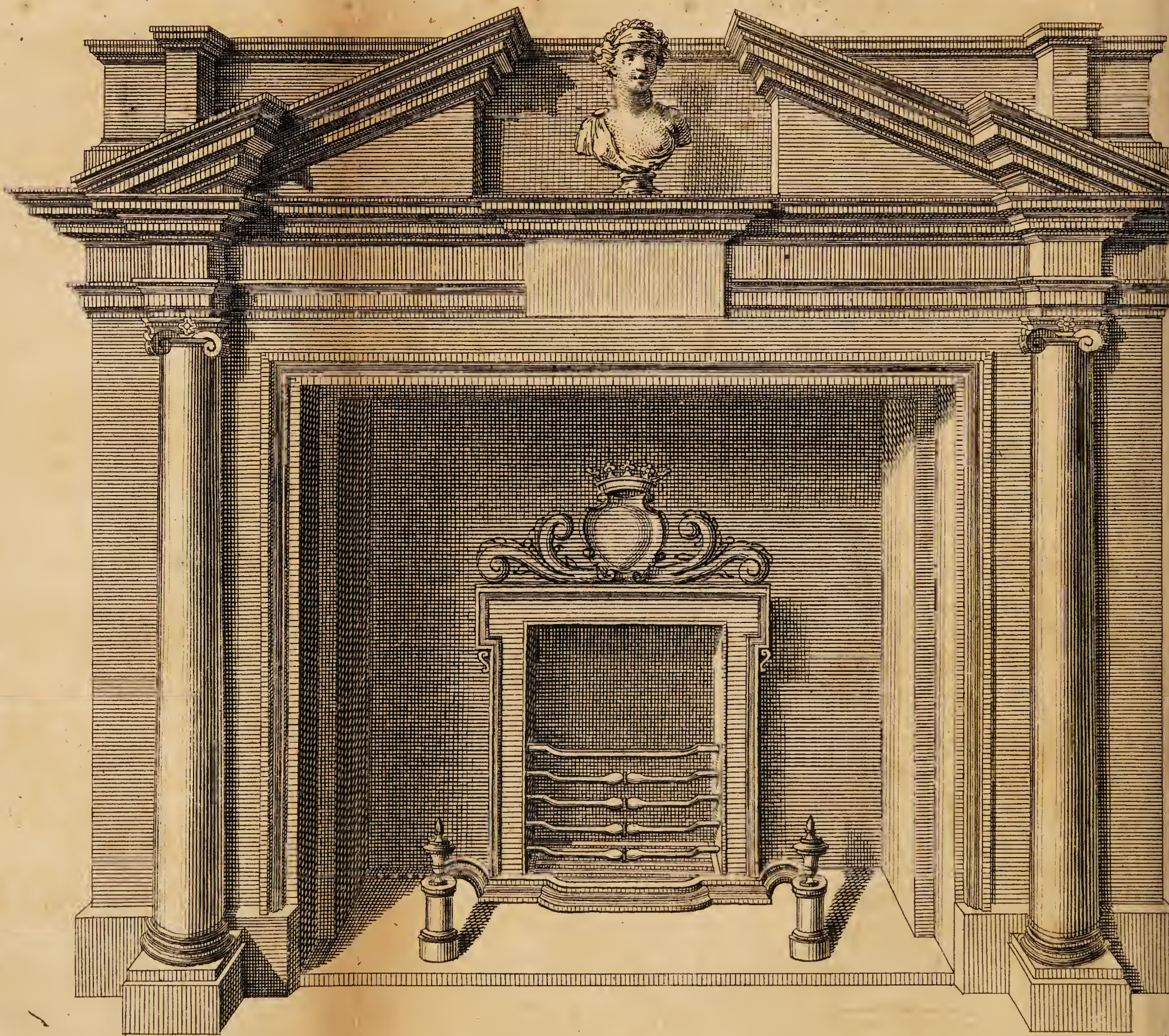
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49 Gauger (Mons.) Fires Improved ; or, a New Method
of Building Chimnies so as to prevent their Smoking, from
the French by J. T. Desaugiliers, 8vo, 10 *folding plates*
exhibiting the construction, old calf, scarce, 7/6 1736

15-7-23 37

24,164/3/3

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FIRES IMPROVED:
 OR, A
 NEW METHOD
 OF
 Building Chimnies,
 So as to prevent their
 S M O K I N G.

IN WHICH

A *Small* FIRE, shall warm a ROOM much better than a *Large* ONE made the *Common Way*. And the Method of altering such CHIMNIES as are already Built, so that they shall perform the same Effects.

By Monsieur GAUGER.

Made *English* from the *French* Original.

By J. T. DESAGULIERS, L. L. D. and F. R. S.

THE SECOND EDITION,

With an APPENDIX, Containing several farther IMPROVEMENTS made by the TRANSLATOR and OTHERS.

L O N D O N :

Printed for J. SENEX, at the *Globe*, against St. *Dunstan's* Church, in *Fleetstreet*; and E. CURLL, at *Pope's Head*, in *Rose-street*, *Covent-Garden*. 1736. Price 4 s.



PREFACE.



THE Usefulness of this little *Book* * has induced me to give it the World in *English*. The Matter contained in it will be entertaining to every Gentleman; and the Manner of reducing it to Practice, easily comprehended by the meanest Workman. I have omitted whatever I thought superfluous in the *French*, to make way for some Observations of my own, upon this Subject; that nothing might be wanting to render it of general Use.

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Mon-

* Intituled, La MECHANIQUE de FEU.

Monfieur GAUGER has confidered only the Improvement of *Wood-Fires*, but I have fhewn how *Turf* or *Coal* may be burnt in thefe Chimnies, with all the Advantages that he propofes from his New Construction. He has indeed fhewn in his *Preface*, that Contrivances are not the lefs valuable, for being fimple ; however, fome People may admire thofe only that are the Effect of a great deal of Study, and make a Show with a very complex *Apparatus*. What he propofes to do by his New Method, is, 1. To light a *Fire* with the greateft Eafe, and, if you will, make it *flame* all the time without the *trouble of Blowing*. 2. To make a *Room* very warm with a little *Fire*, which may alfo give *Heat* to another *Room*. 3. To difperfe the *Heat* fo uniformly as to take away the ufual Inconveniencies of being obliged to creep
near

near, or to sit at such a Distance from the *Fire*, that we are either *roasted* before, or *frozen* behind.

4. To make us breathe fresh *Air* constantly, which shall be of any degree of *Heat* that you would have it, without ever being troubled with *Smoke* or *Moisture* in any part of the Room. 5. To shew how to extinguish by one's self, and in a Moment, any *Fire* that should happen in such Chimnies.

Long Experience in his Use of the *New Chimney* has confirmed the fore-mentioned Particulars; and what is remarkable, is, that in the severe Winter of 1709, when *Water* would freeze by the *Fire-side*, almost every where else, it was not at all frozen in his *Closet*, tho' exposed there all Night, and the *Fire* continued no longer than till Midnight.

His Treatise is divided into three Books; the *First*, shews the Incon-

veniencies of the common, and the conveniencies of the *New Chimnies*.

The *Second*, gives the Reasons why the *New Chimnies* cannot possibly smoke.

And the *Third*, which is purely *Practical*, informs the *Workman* in such an easy Manner, that they may without any farther Directions perform what is required; in a *more or less*, simple Manner, as any Gentleman shall think fit.

Channel-Row, Westm.

May 3. 1715.

J. T. Desaguliers.

Advertisement.

HIS MAJESTY has been graciously pleased to grant his Royal Letters Patent to ROBERT PHILLIPS, of *Great Queen Street*, near *Lincolns-Inn-Fields*, for the New Invented MACHINE FIRE-GRATE.

This

This Invention so infallibly prevents the smoking of the Chimney in which it is rightly fixed, that the Room will be free from Smoke or any offensive Smell. The Fire is immediately blown up, and equally spreads a gentle Warmth throughout the Room; which may be increased or decreased at Pleasure, (as may be observed by a Thermometer) keeping the Room warm all Night after the Fire is put out, thereby preventing unwholesome Air or Smoke coming down from any other Chimney.

In these Grates you have the Sight of the Fire; and they are as useful, and near as cheap (considering their Ornaments) as any other Grate.

By this Method you have both *fresh* and *warm Air*, which is warmed in the same agreeable Manner within, as the Sun warms it without; the Rays of Heat passing thro', and rarifying it, causes it to be

as dry and wholesome within, in foggy or wet Weather, as it is abroad in the finest Day of Summer; and those who are troubled with the *Phthysic* breathe in it more freely.

These Machines are fixed in a few Hours, and are of excellent Use in large Halls, Hospitals, Schools, Green-Houses, and in all Places where People may have Occasion to sit in wet or cold Weather, and to do Business near a Window, and far from a Fire; a very great Conveniency is, that Rooms are kept free from *Damps* and *Smoke*, by which Paintings and other valuable Furniture are preserved.

The Approbation they have met with from those who have already purchased them, (particularly in the Royal Courts, and at the Houses of many of the Nobility) is a sufficient Testimony of their Usefulness.





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FIRES IMPROVED.

BOOK I. PART I.

CHAP. I.

Concerning FIRE, its Rays of HEAT, and the Way that we are warmed by it.



AS luminous Bodies throw out Rays of Light every way round, so does Fire dart out every way *Rays of Heat*; for whatever way we come near the Fire, we may be sensible of their Impulse, which gives us a Sensation of Pain when we come too near.

By the *Rays of Heat* are meant, the Particles of the Fuel which are darted from the Fire; and are propagated round about, either directly, that is, when they come immediately from the Fire, or by Reflection when they are beaten back from Bodies against which they strike; and, as they are reflected, they follow

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the same Laws as the Rays of Light, having their Angle of Incidence equal to that of Reflection.

All Rays of Fire, except those that go strait upwards, whether direct, or reflected, must move in a Line, which it is perhaps impossible and wholly needless to describe: For, as well as the Rays that are darted in an horizontal, as those that are sent out in an inclined Direction, must also have a Tendency perpendicularly upwards; because Experience shews us, that all little Bodies heated, endeavour to go upwards: Thus in Water or Air, the warmest Particles go towards the upper Parts, and still rise as they are heated. A Ray of Heat then goes on by a compound Motion made up of its Impulse, according to the Direction which it receives from the Fire, and its constant Tendency upwards; so that the farther a hot Particle is gone from the Fire, the higher it has ascended.

The Use of this Consideration will appear in the following Pages.

Fire may give Heat to a Room, and the People in it.

1st. By its direct Rays.

2^{dly}. By its reflected Rays.

3^{dly}. By a kind of *Transpiration*, that is, when its Heat is transmitted thro' a solid Body, as in the Case of Stoves.

By

By the Heat of the Fire, is meant, that Motion of its Parts, which causes in us that Sensation which is called Heat; and sometimes Pain, when it is too violent.

In common Chimneys the Fire gives no Heat by *Transpiration*; sends forth but few direct Rays, and fewer reflected ones, as will appear in the next Chapter; but in the Chimneys described in this Treatise, the Fire sends out more Rays into the Room, and warms much more by *Transpiration*, than by its direct or reflected Rays.



CHAP. II.

The common way of Building Chimneys with the Jams parallel, and the Breast inclined, is not proper for reflecting Heat into a Room.

[Fig. 1.] **S**upposing the Fire *Ff* in a common Chimney *ABba*, whose Sides or Jams *AB, ab*, are parallel to each other, the Ray of Heat *fG*, will be reflected to *M*; the Ray *fH* upon it self into *f*; the Ray *fI* into *N*; and the Ray *fL* into *P*; and as the Ray *fL* going from *f* to *L*, constantly rises, as it does also when after Reflection it goes from *L* to *P*, [Fig. 3.] it must get within the

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Flue

Flue before it reaches P, and then wherever it strikes against oR , the fore Part of the Funnel, which is inclined to the Horizon, it will be reflected upwards into the Chimney, always supposing the Angle of Incidence equal to that of Reflection, and therefore it cannot go into the Room.

[Fig. 1.] Thus if we examine all the Rays that fall between H and a , we shall find that none can be reflected into the Room except those that fall upon the Extremity of the Jam towards a ; but as they have lost most of their Strength before they can get thither, upon account of their Distance from the Fire, they are but very weakly reflected, and therefore give but little Heat; besides Jams of Plaister are very unfit to reflect Heat, by reason of their Softness and Porosity.

The Ray fH being reflected upon it self to f , cannot enter into the Room.

The Ray FG, which is reflected to M. whatever Reflections it undergoes afterwards, must necessarily go up into the Chimney, and can go out no other way than at the top of the Funnel; the same will happen to all those that are reflected between H and Bb ; as also to all the Rays which fall from F upon AB; and from this we may judge of the Effect of those which going from any part of
the

the Fire fall upon the Jams AB, *ab*.

[Fig. 3.] All the other Rays as FAB, which going from the Fire F, strike against the Back, if they have ascended ever so little above the Level of that Part of the Fire, from whence they came before they struck the Back, make a very small Angle with it; and, therefore, after Reflection go up the Chimney, or if any of them, as FGMN, strike against the Breast oR, a second Reflection throws them within the Chimney, where they rise and are lost: Therefore scarce any but direct Rays which come from the fore Part of the Fire can come into the Room to warm it, and even those must come forward in an horizontal, or nearly horizontal Direction; for such as are ever so little inclined, rising as they go from the Fire, are almost all got into the Funnel before they have reached the under Part of the Chimney-Piece, as FI, and striking upon the Breast oR, which is inclined, they are also reflected into the Chimney, and become useless; as for the Rays that go upright, nothing can hinder them from getting out at Top of the Chimney.

Therefore the common way of Building the Breast and Jams of the Chimney lets so few Rays of Heat come into a Room, as to make the Fire of very little Use.

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Of late, indeed, Builders have rounded the Corners of Chimneys, covered the Jams or Sides with Plate Iron or Brass, streightened the Breast to make Flats under the Chimney-Piece, carried the Flue or Funnel bending, and by that means have given more Heat to the Rooms; but the Method mentioned in the next Chapter will out-do all that.



C H A P. III.

Parabolical Jams, and an horizontal Plane under the Chimney-Piece, are the fittest for reflecting Heat into a Room.

GEOMETRY teaches, that all Rays which coming from the Focus of a *Parabola*, strike upon its Sides, after Reflexion go on parallel to the Axis.

[Fig. 2.] If therefore on the back Part of the Hearth of the Chimney $ABba$, you take the Length Cc , equal to the Length of the Wood that you would burn, as for Example of 22 Inches; and from the Points Cc you draw the Perpendiculars CD, cd , for the Axis of two half *Parabolas* whose *Vertex*'s are Cc , and Aa the Distance of the Breadth of the Chimney be two Points of the said *Parabolas*; then if those Parabolic Jams AC, ac , be covered

covered with Plate Iron, Brass, or Copper, and *oim* [Fig. 3.] the under Part of the Chimney-Piece be made parallel to the Horizon, and as broad as may be, leaving only 10 or 12 Inches for the Passage into the Funnel; I say, this Chimney will not only reflect a great deal more Heat than common Chimneys, but as much as any Chimney can possibly do.

[Fig. 2.] For if *Ff* be the two Focus's of the half *Parabolas*, when the Billets, whose Length we also suppose *Ff*, are on Fire, the Rays of Heat darted from the said Focus's *Ff*, which in common Chimneys cannot go into the Room, and so are useless, will here be reflected parallel to the Axis *cd*, to *m, q, n, p*, and consequently go into the Room; and those which ascend forwards at 12, 15, or 20 Inches from the Back, and in the common Chimneys would upon Account of the Inclination of the Breast *oR*, [Fig. 3.] be reflected inwards, will here strike against the Plane *oim*, which is parallel to the Horizon, and therefore be reflected into the Room: So will the Rays *FGm*, if their first Angle of Reflection be sensible, and by that means come into the Room towards *n*; and much more the Rays *Fil*, which come directly, and therefore with a greater force from *F*. More-

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Moreover, tho' the Chimney be as wide as in the first Figure, the Jams are much nearer to the Fire, and therefore will reflect more Heat and more strongly; then the Plane *m i o* not only throws back into the Room, the direct Rays as *F i l*, but also those that are reflected from the Back, as *FG m n*.

[Fig. 2.] If we examine the Rays which come from any part of the Fire between the *Focus*'s of the *Parabolas*, tho' they are not reflected from the Jams in such manner as to go on parallel to the Axis *CD, cd*, yet they will all be reflected obliquely into the Room, as *FHI*.

[Fig. 3.] Some may imagine that the Plane *m i o* being Horizontal, and going so near the Back, may cause the Chimney to smoke; but we shall hereafter shew that the Effect will be quite contrary.



C H A P. IV.

Of the Vent-Hole or Bellows; the Reason of its blowing, and the Manner of its increasing the Heat, and causing it to be reflected.

[Fig. 2, 3.] **I**N the middle of the Hearth, at about ten or twelve Inches distance from the bottom Plate, must

must be made a Trap-Door Z, that may easily open and shut, and under it a little hollow Passage communicating with the outward Air; when this Trap-Door is lifted up a little way, the Air from without will go out thro' the Passage X of the Bellows or Vent-Hole; for there will always be a greater Pressure of Air from without, than from within the Room, whether the Wind blows, or the Weather be calm; if there be a Fire in the Hearth, because the Heat of the Fire rarifying the Air, and driving part of it up the Chimney with the Smoak, there will be a kind of *Vacuum*, or at least, the Air will be made so thin over the Vent-Hole, as to press less than that which is coming from without; the external Air therefore will rush in violently, and not only light the Fire, but cause it to flame, even tho' the Wood should be green, and also forcibly drive the Flame and Rays of Heat, as FG *mn*, FST, so as to make them beat back into the Room after one or two Reflections, when the Fire is lighted.

The Use of the Vent-Hole is not only to light the Fire, and cause it to flame, but it has several other Advantages, as will appear in our Second Part. Neither is the Invention of it new; for I myself used it five-and-twenty Years ago, having

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having seen the Use of it in other Places; but then it served only to light the Fire.

N.B. Monsieur GAUGER in his fifth Chapter, only shews the way to describe the *Parabolical Jams* of the Chimney, and give Demonstration of his Method, but it is so easy to perform this, that we shall pass it over; especially, since he refers us to an easy way of drawing them nearly *Parabolical*, which you will find in Book III; and in Practice it will do as well as if they were *truly Parabolical*, as they consist of a strait Line and an Arch of a Circle.

This way of making the Jams *nearly Parabolical*, as in *Fig. 2.* and the Plane under the Mantle-Tree Horizontal, as *Fig. 3.* will be of little Cost, and great Advantage to Chimneys already built; especially if the Vent-Hole be added; but those who will add the Contrivance behind the Back of the Chimney, will reap several other Advantages from it, as will be shewn hereafter.

BOOK



BOOK I. PART II.

CHAP. I.

Concerning the sudden Heat given to the Air; and how the warmest Air gets above that which is cold.

AN Experiment or two, made to this Purpose, will best prove what I affirm.

EXPERIM. I.

I took an Iron Tube of three or four Inches Bore, bended in the manner of a Syphon, and fitting the longest Leg of it so into the Wall, that the North Wind from without came into it freely; the Air that came into the Room thro' the Hole of the short Leg, was cold enough to freeze Water; but when I laid the said short Leg upon the Fire, the Air rushed in thro' the Tube with the same Violence as before, and rather swifter, and very hot, tho' the heated Part of the Tube was but about a Foot long.

Now

Now a Chimney cannot warm Air after this Manner, and yet appear handsome ; because, tho' we suppose the Back and Jams of it hollow behind, and Plate Iron or Brass between the Fire and the Cavity ; yet Air passing thus behind, cannot be so heated, as if there was a Fire round it, as in the Case of the Tube : But Hollows may be so contrived, as to warm a Room in a little Time, how cold soever the Weather is, which is all that is required here.

Another Property of the Air is, that the warmest Air always gets above the cold. To be certain of it, and know the Difference of Heat, at Top and Bottom of a Room, I made the two following Experiments.

EXPERIM. II.

I hung up two *Air-Thermometers* in my Room, the one at Top near the Cieling, and the other at Bottom near the Floor, and the Liquor ascended much higher in the upper than in the lower *Thermometer*, tho' it was farther from the Fire than the other ; then changing the Places of my *Thermometers*, the Liquor in the upper still would rise, whilst that in the lower descended. This succeeded all the several Times that I tryed it ; and
when

when I took the upper *Thermometer* down to the middle way, betwixt the Top and Bottom of the Room, and took up the lower *Thermometer*, to see close to it, the Liquor subsided in that which had been the upper *Thermometer*, and rose in that which had been the lowest; which shews, that in a Room where there is a Fire, the lowest Part of it is the coldest Place, and the higher you go, the warmer is the Air; whence may also be concluded, that the lower the Cieling of a Room is, the better it is for warming ones self in Winter.

EXPERIM. III.

Take a Gun Barrel, or any other Iron Tube, open at both Ends, and laying the middle of it horizontally upon the Fire, you will feel a little Heat coming out at each End; but if you lay it assaunt, the Air will rush out with Force enough to blow out a small Wax Candle at the upper End of the Tube; which will be warm from the Fire to the upper End, whilst the other Part of the Tube from the Fire downwards will remain cold: Then if you change Ends, still the Air will rush out at the upper End, which will be warm, and the lower End will become cold, even tho' it should be the shorter

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shorter End; nay, tho' you should stop the lower End close, yet you would feel some warm Air come out at the upper End, tho' not with so great Velocity as before.

If such a Tube be bent, the Experiment will be much more sensible; and, indeed, any one that considers how Heat affects the Air, will be convinced that the Thing must necessarily be so; for the heated Air being rarified, becomes specifically lighter than the cold Air, and so must get above the cold.

N.B. *Whilst an Oven is heating, and the Flame rushing out; any Body may put in their whole Arm near the lower Part of the Oven, without feeling any very great Heat, tho' it be quite otherwise as soon as the Fire is put out.*



C H A P. II.

The inner Fabric of the inside of the Chimneys; how the Air goes into the Hollows, is warmed, and then successively warms the whole Air of the Room; how the Air of another Room may be warmed there, and other Advantages of this Contrivance.
[Fig. 6.]

WE suppose the whole Compass AHC, *cha* of the inside of the Chimney covered with a Plate of Iron, Brass, or Copper; and behind it a void Space about four Inches deep, divided by several Partitions, which form several Cavities, Cells or square Tubes, the first communicating with the second, and the second with the third, and so on; making altogether as it were a sort of a recurved Canal, one of whose Ends D must be at Bottom, and the other at Top of one of the Jams coming out into the Room; so that the Air can go in at the lower End D, and go out at the upper End of it R.

We may also suppose the under Part of the Hearth hollow, and covered with Plate Iron; nay, and the under Part of the Chimney-Piece likewise hollow, like a Pipe; so that all the Cavities behind the Back, Jams, under the Hearth and
Chimney

Chimney-Piece altogether make the fore-mentioned winding Passage.

We shall in the Third Book determine the different Bigness, Contrivance, and Situation of those Cavities, and how to fit them to larger or smaller Rooms; but their Effects we shall shew in the following Chapters; we are only now to take it for granted, that the Fire made in the Hearth, can warm some one of the Surfaces; of each of those communicating Cavities.

Now supposing this Passage for the Air behind the Chimney; as soon as a Fire is made, it will warm the whole Compass of the Chimney, the Hollow under the Hearth and the Bottom and Backside of the Passage under the Mantle-Tree (if there is one) and consequently the Air within the Hollows that those Surfaces shut up, and the cold Air, which will come at the lower Entrance D, will begin to grow warm in the first Cavity; then as it comes thro' the second, its Heat will increase, still it will grow hotter in passing thro' the third, &c. so that it will come out very warm, thro' the upper Hole R or r

As long as there is any Fire in the Room, there will by this means be a constant Circulation of the Air, thro' those warm Hollows, because the Air in
them

them being rarified, will be succeeded by the more dense; and therefore stronger Air which comes in at the Bottom D, and having received a great Degree of Warmth in going thro' all the Hollows, it goes out at R, and gets to the upper Part of the Room, the cold Air all the while coming down and succeeding at D, till the whole Air in the Room has passed thro'; which it may do, till it has acquired what Degree of Warmth you please.

The Advantage of those Cavities, consists in the long Journey of the Air thro' them; for if there was only one great Hollow, the Air could not have Time to receive a sufficient Degree of Heat, especially if it came in from without Doors.

Not only the Air of the Room, in which the Fire is, may be warmed by such a Circulation; but if you bring in the Air from another Room (in which there is no Fire) thro' such a Channel, so that it may come from the lower Part of it, and go into the Hole D, a large Pipe also going from R to the upper Part of the said Room, after a few Circulations, it will be sufficiently warmed: Which will be of no small Advantage in several Cases.

This Way of warming a Room, gives Heat to all the People in it, tho' at a Distance from the Fire ; keeps every Place dry, still leaving the Moisture that it had, or gets in circulating thro' the Room, in the Cavities behind the Fire : So that no Moisture, even in the greatest Thaws, can Damage the Goods in such a Room.

When the Air of the Room is sufficiently warmed, you may hinder it from receiving any greater Degree of Heat, without putting out or diminishing the Fire, if you shut up the Hole R, where the warm Air comes in.

If you should only shut up the lower Orifice D, warm Air would still continue to go out at Top, but in a smaller Quantity, as we shewed in the foregoing Chapter, that it would go out at Top of the Iron Tube, tho' it was stopped at Bottom ; because as the warm Air went up, cold Air would go in its Room to the Bottom, and so a constant Circulation of it would be made there.



C H A P. III.

After what Manner the abovementioned Cavities may be made use of for warming a Room, by letting in the external Air through them, tho' the Air be never so cold; the way that such Air goes into the Room, how it warms it, and the Manner of knowing in what Time it will be sufficiently warmed, how it may serve to encrease or diminish the Warmth, without encreasing or diminishing the Fire. [Fig. 6.]

IF the outward Air be brought into the Cavities behind the Chimney, by carrying on a Communication from the Hole D, quite out of the House, the Room may also be warmed, and sooner, as well as to better purpose, than when we only cause the Air in the Room to circulate; for in the first Case, the Air that goes out of the Hollows after it has acquired a Degree of Warmth in passing thro' them, warms the cold Air of the Room, only by mixing with it, and communicating some of its Heat to it; and as the warm Air that goes out every Moment is but in a small Quantity, in Comparison to that which fills the whole Room, a considerable Time must be taken up, before all the Air in the Room is sensibly warmed, especially when the

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Weather

Weather is very cold, and the Chamber is very large; for that Air does not go thro' very fast: But it is quite otherwise when we make Use of the external Air; for besides that a great Quantity will then go out in the same time, thro' the Hole R or r, because it goes quicker, as it is always more pressed from without, than from within the Chamber (as we have already hinted.) This is not only done by this warmed Air, bringing its Heat into the Room, and warming the People in it; but by its driving out the cold Air, and succeeding instead of it. And that is performed in the following Manner.

The warmest Air always rises above that which is colder, and therefore the outward Air, which comes into the Chamber, after it has passed thro' the Cavities of the Chimney when there is a Fire, becoming warmer than the rest of the Air in the Room, gets above it quite to the Cieling, and so much Room as it takes up, so much of the cold Air below is driven up the Chimney, as being the only way that it has to get out at; and, therefore, after the Fire has been lighted some time, all the Air that was in the Room, before the Fire was made, has been driven away up the Chimney, by the Push of the external Air, which comes in warmed. Now, since in Time
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all the cold Air will be gone out of the Room, it may be required to know in how long Time that will happen; which may be found after the following Manner.

[Fig. 6.] If a Piece of Paper P hangs from the Cieling by a Thread, over-against the Hole *r*, thro' which the warm Air comes into the Room, that Air will drive the Paper before it as it comes into the Room: Now if the Paper be driven two Feet in the fourth Part of a Second, the Hole being six Inches Square, then will more than two cubic Feet of Air come into the Room, in one Second; for as the Air spreads every way, as it comes out of the Hole *r*, it will push with less Force against the Paper, the farther the Paper is from the Hole; thus if more than two cubic Feet of Air come into the Room in one Second, about 125 square Feet will go in during the Space of a Minute, if the Velocity with which the Air rushes in, be such as we suppose it; but it is always greater, if the Wind blows ever so little.

Now if we suppose the Contents of the Room to be 2000 square Feet; then in 15 Minutes, or a quarter of an Hour, as much Air as it can contain, will have entered into it; and two or three Times more if its Velocity, or the Hole *r*, be greater than we at first supposed.

Nevertheless, we must not conclude, that all the cold Air which was in the Room, is absolutely gone out of it; for some of the hot will mix with the cold that goes out up the Chimney, but we are at least certain, that the greatest Part of the cold Air is gone out, and therefore, that the whole Air will in a Quarter of an Hour be very much changed, and well warmed, and that in Half an Hour it will be wholly changed. Not that the Air which remains in the Room after that Time, is as hot as the Air which comes into it from the Hollows, because as this Air comes out, and goes up towards the Cieling, it passes thro' Air colder than it self, and therefore as it warms it, it must lose of its own Heat; but then as the Room grows warmer, this entering Air loses less and less of its Heat every Moment, because, as well the Cavities, as the Air in the Room, are more and more warmed; and therefore in a Quarter of an Hour, or Half an Hour's Time, the Heat will be sufficient to warm every Body in the Room.

Air coming this way into a Room, not only drives out the cold Air, but hinders it from coming in under Doors, or, thro' Casements which don't shut close, or at least, from coming in so fast as usually; for the Room being always full,
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the external Air meets with more Resistance, and that little which may come in, enters with less Force, and mixing it self with the warm Air as it comes in, is heated before it can reach the People in the Room; and, therefore, can no way be troublesome to them, unless they are too near the Doors or Windows. Nay, every Crack or Passage in a Door or Window, and every little Cranny may be stopped up close without fear of the Room smoaking; whereas, when Chimneys are built the common way, sometimes the external Air must be let in at the Door or Window to keep the Chimney from smoaking.

[Fig. 6.] There is indeed an Inconveniency, which is, that warm Air entering continually, will at last make the Room too hot; but this is easily remedied by stopping up the Hole *r*, where the hot Air comes in; but then as there would no longer be a Circulation of fresh Air, it is better to have a direct Communication with the external Air near *R* or *r*, the Place where it comes out after it is heated in the Hollows. Thus you may sometimes have hot, and sometimes cold, and sometimes temperate Air, in what Proportion you please, by opening sometimes one Hole, sometimes the other, and sometimes both. We shall in the

third Book give the Method of doing this conveniently.

If any one would have the warm Air that comes into the Room, to fall with all its Heat on their Hands or Feet, to warm them in a little Time, and keep them warm at any Distance from the Fire, they may easily do it, by setting one End of a Tin or Pastboard Pipe, at the Hole R or r, where the warm Air comes in, and the other End near the Part which they would warm: Such a Pipe may be carried into a Bed, and warm it to any degree, by discharging its heated Air into it; and as such a Tube takes up but little Room, the Bed may be warmed whilst any Body is in it, and the warm Air may be thrown upon any Part of the Body, so as to warm it as long as you please, which will be of great Use, especially in some Distempers, where it is required to apply warm Napkins constantly to a Patient; those that can get no Heat in Bed in hard Winters, may be thus warmed.

The Circulation of the Air of the Room might serve for those Uses, but very weakly, for Reasons before shewn; neither will it be so proper as this way, for keeping the Goods in the Room from Moisture.

C H A P. IV.

To shew that when a Room is warm'd by Air which is constantly new, it will defend us against several Inconveniencies, and especially the Ladies; that it is of great Advantage to sick People, and those which visit them.

TO be soon and agreeably warm'd by External Air brought into a Room after the above-mention'd manner, is not the only or the greatest Advantage reap'd by our new Invention; for as well the Inconveniencies of a great Fire, as that of extreme Cold are remov'd. The larger Particles of the Fuel darted out against us, when we have too large a Fire, or when we are too near the Chimney, burn and dry up the Lungs, and ruin the Eyes, as may be perceiv'd by their Pain and Redness; spoil the delicate Skin of the Ladies, hurt the Eye-lids, and destroy the finest Complexions; all which Evils are prevented by the Use of the new Chimneys.

As for sick People, they may be look'd upon as absolutely necessary; for the corrupted Breath of Patients, the ill Humours which go out of their Bodies by Transpiration, Particles from their Physick, and their Excrements mixing with the Air that continues always the same
(because

(because we dare not in cold Weather open any Place to let in fresh Air) vitiate the Air more and more ; and the Patient has the Infection of the Air to struggle with, as well as his Distemper ; which often occasions the Death of those that are sick, and sometimes that of such as visit them pretty much.

Now if fresh Air from the Hollows of the Chimney be let into the sick Man's Room, of what Degree of Heat is thought most proper, it will drive out the corrupted Air, and so take off all the Inconveniences which must necessarily be occasion'd by Air impregnated with too many poisonous Particles. Besides, since we can give the Patient what Degree of Warmth we please, there will be no need of loading and choaking him up with Blankets after the usual Manner.



C H A P. V.

External Air thus introduc'd, can be of no ill Consequence ; but, on the contrary, is very proper for Health.

Some perhaps may be apprehensive that warm Air is unwholesome, which I grant of very hot Air, especially when its heat proceeds from a Mixture of hetero-

heterogeneous Bodies, as Parts of the Fuel from a very great Fire, and as it is found in Air heated by Stoves; but the case is different where you have temperate Air, that changes continually; it is the fittest for Winter, or at least the most wholesome. This Experience and Reason will easily shew: It is not only certain, that the Air becomes temperate and purer, by passing through the Cavities of the Chimneys; but it is to be observ'd, that cold Air takes from us part of the Heat that is required to keep us in Health, and its Particles are so rigid, that the Motion which the Heat of our Bodies can give them, makes 'em strike so forcibly, as, in some measure, to break the Continuity of our Parts, by tearing our Fibres, and especially damaging our Lungs, (into which the Air rushes continually,) and so causing several Distempers.

'Tis observable, that if after a Frost the Sun shines pretty warmly on Flowers, that Heat gives such a Motion to the rigid cold Particles that were fix'd on the Flowers, as to tear and blast them. This we our selves are sensible of, when coming out of the frosty Air, we approach too near the Fire; for then we feel a sharp Smarting from the sudden Motion of the frozen Particles of Water, which sometimes proves very fatal, in causing the Loss
of

of Limbs ; but if we are gently warm'd, these small Ificles will be melted, reduc'd to Globules, and so blunted, as to be unable to hurt us when their Motion is increas'd by a greater Degree of Heat.



C H A P. VI.

That such as make use of Rooms warm'd after our Method, are less apt to catch cold when they go out.

SOME People have objected against the use of our new Chimneys, that going out of a warm Room into the cold Air, would make one apt to catch Cold ; but Reason and Experience will shew the contrary: Do we not every Morning get out of a warm Bed to go into the Cold, and put on Cloaths much less warm than the Bed? It is a Mistake to imagine in common Cases, that People that are us'd to great Fires, catch Cold when they go into the Air, upon account of the Warmth of the Room which they come out of: It is rather the Cold which they feel in the Room, when one part of the Body is cold, whilst another is almost burn'd. The irregular way of warming ones self, occasions those Inconveniences. When the Warmth is regularly communicated to
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the whole Body, it is much longer retain'd: A Person warm'd by our Chimneys, will be in the same Condition, as those that slide, skate, or use any other violent Exercise in frosty Weather.

It is about nine or ten Years since I first us'd this new Contrivance, and I have not once catch'd Cold since, tho' I us'd to have a Cold two or three times every Winter before. The *Danes*, *Germans*, and other Northern People, who make use of Stoves, wonder at our way of warming our selves in Winter, saying, that either we sit in the Cold to see Wood or Coals burn at a Distance, or else, by coming near the Fire, add the Pain of Scorching to that of the pinching Cold. They easily bear with the smothering Heat of Stoves, to avoid the other numerous Inconveniencies of an hard Winter; which our Chimneys wholly take off, without troubling us with any of the ill Qualities of Stoves.

C H A P. VII.

That a little while after the Fire is kindled, the External Air gives Heat to the Room, tho' it feels as if it were cold when it comes in. [Fig. 6.]

IN very cold Weather, as soon as you begin to kindle the Fire, the External Air passing only thro' very cold Cavities, must needs cool the Room as it comes in; therefore one might, during some Moments, shut up the Hole R where it comes into the Room, till the Fire burns, and the Hollows are a little warm'd; but then there would be some Danger of being troubled with Smoke whilst that Hole was shut up, therefore in such a Case it is better to leave it open, and blow up the Fire as soon as may be, for the bottom Plate will be immediately warm'd as soon as it beats against it; and then the Air which comes thro' the Cavities, tho' it feels cold as it comes into the Room, will not only not cool it, but even warm it; and the same Air when it feels temperate, will give more Heat than the Air of the Room made to circulate, tho' this last feels very warm; several Experiments have convinc'd me of the Truth of these two Paradoxes, some of which I shall give here.

EXPERIM. I.

EXPERIM. I.

The Fire being kindled in my Room, I found that my Thermometer rose whether the Hole R was shut or open, which is a Sign that the Room is not cool'd by the Admission of this new Air from without, tho' it feels cold as it comes in.

REMARK.

For the right Understanding of this and the following Experiments, it is to be observ'd, that besides the general Cause of Cold, which is the Rest of the Parts, the Coldness of the Air proceeds sometimes from the Quality of its Parts, sometimes from their Determination, and sometimes from both together.

1st. The Coldness of the Air proceeds from the Quality of its Particles; as when they are rigid, frozen, and almost without Motion, or at least mix'd with watery Particles that have those Qualities, as it happens in Winter, in a hard Frost, when the Wind blows but little; this Sort of Cold acts strongly on all it reaches, especially inanimate Bodies, as Rivers, Trees and other Plants; much more than when there is a Wind. It causes a Smarting also in Animals, for then the pointed Particles, like

like so many Needles, penetrate farther than the outward Skin.

These Particles, mix'd with the Air, make the Cold so sensible in the Morning when the Sun rises, after a frosty Night, especially if there be a hoar Frost upon the Ground; for then the Sun raises those stiff Particles before he has blunted or melted them, and they fix on whatever they meet with, entering into the tender Parts of our Bodies, and so give us a more vivid Sensation of Cold, than any Cold in the Night-time.

2dly. The Coldness of the Air proceeds from the Determination of its Parts, when they have been violently driven the same way. Thus fanning, blowing with Bellows, or strongly with our Mouths, makes that Air feel cold or cool, which is otherwise warm; but this sort of Cold is only such, in respect to our selves; it is not communicated to inanimate solid Bodies, nor even to Liquids when they are shut up in Vessels; this is the reason why the same Air that appears cold to us, does not cause the Liquor of the Thermometer to descend in the foregoing Experiment. Here follows another Experiment, which I have often made with the same Success.

I have for a long time together, with a Pair of Bellows, blown on the Balls of two different Thermometers, whose
Liquor

Liquor has constantly risen, tho' it felt cold to my Hand as it came out of the Bellows. The Air was drawn into the Bellows near the Thermometer, and the Liquor would rise most when the Weather was very cold, and the Liquor was but a little height above the Ball, before I began to blow.

Setting a long Tube to my Mouth, I blow'd upon my Hand, and the Air felt cold; but when I blowed upon the Thermometer, the Liquor would rise: If the Tube was added to the Nose of the Bellows, the Air would feel colder when it came out, than if I blow'd with the Bellows only; but then the Liquor in the Thermometer would still rise, tho' not so high as when blow'd with the Mouth, because in the last Case the Air was heated in passing thro' the Lungs.

3dly. The Coldness of the Air is occasion'd both by the quality and determination of its Parts; when those Particles being frozen or mix'd with frozen watery Particles, and each of them singly, being almost void of Motion, they are altogether carried in a right Line, as it happens in Winter during the great Winds, especially those that blow from the North: And Cold of this Nature is always more sensible than when it proceeds only from the Determination of the Parts. The
D Difference

Difference between the Action of Cold Air upon animate and tender, or inanimate and insensible Bodies is this ; That when Air loaded with the abovemention'd pointed Particles is driven violently against our Bodies, the cold sharp Particles are driven into our Flesh, and affect us strongly ; but when they strike upon hard Bodies, they pass over them, without fixing to them, as we may often find that there is a harder Frost when the North Wind is less, than when it is more violent. On the contrary, when hot South Winds blow hard, they cause in our Bodies a Sensation of Coolness ; but feel hot when they blow but very gently, tho' the Thermometer rises as much in the first, as in the last Case ; but this will be farther explain'd when we consider the third and fourth Experiment.

EXPERIM. II.

I found that when the External Air had pass'd thro' the warm'd Cavities behind the Chimney, tho' to the Feeling it was but of a moderate Heat, it warm'd the Room more, and caus'd the Liquor in the Thermometer to rise higher than the Air of the Room, when circulating thro' the same Cavities, it felt much hotter as it came out at the Hole R.

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One of the Reasons of this Phænomenon, is the Direction of the Parts of the External Air, which comes in with a great Swiftnefs, and so (for the Reasons given in the foregoing Remark) causes a relative Cold only.

A second Reason is, That the External Air comes into the Room in a greater Quantity than the Air taken into the Room, because it comes in swifter.

The third Reason is, That the Air of the Room, after coming out of the Hole R, only warms the Chamber by mixing with it; whereas the External Air is constantly driving out the cold Air.

The fourth Reason is, That the Air from without coming in very fast, keeps the Room always full, and so hinders the cold Air from coming in under Doors, or thro' any Crannies.

The last Reason is, That when the Air constantly comes in from without; you have always more dense Air in the Room, it being more press'd; so that any Body that is heated, has a greater Quantity of this warm Air about it, than it would have of other Air of the same Degree of Heat, and therefore is acted upon by more Particles of Air in Motion, which must consequently communicate more Motion to its own Parts.

EXPERIM. III. [*Fig. 6.*]

The Fire being lighted, I have often held the Ball of my Thermometer at the Hole R, where the External Air comes in, and it never sunk there, tho' it often rose; but if I open'd my Window, and held the Thermometer near it, the Liquor would subside considerably.

The Reason of this appears to be, that the External Air was only cold by the Determination of its Parts; but the Air that came in at the Window, was colder by the Quality of its Parts (for it froze then) than by their Determination; so that it must then cause the Thermometer to subside, and would have cool'd the Room very much, if it had been let in then, as we have explain'd elsewhere.

EXPERIM. IV. [*Fig. 6.*]

Holding the Thermometer to the Hole R, when the External Air came into the Room, so as to be lukewarm to the touch, and then holding it to the same Hole, when the Air taken from within the Room comes out, so as to feel very warm; I found the Liquor to rise no higher in this last Case, than in the first; because the External Air felt only colder, upon account

count of the Determination of its Parts ; and coming out in greater Quantity, more Parts of it encompass'd the Ball of the Thermometer, and more fine Ethereal Particles were driven into the Liquor.

From the foregoing Observations and Experiments, we may conclude, that the External Air need not come very hot into the Room to warm it ; if it be temperate, it is enough.

That we are not to judge of Heat or Cold only in respect of our selves ; because that kind of Cold which affects us most, does not affect insensible Bodies so much ; and so on the contrary.

That it is a Mistake in those who would be affected with the same Degree of Heat, to have their Room just so hot as to keep the Thermometer at the same Degree ; because they shall be differently affected, according to the greater or less natural Heat of their Bodies at that time.

Most People have observ'd, that the Air in Cellars feels warm in Winter, and cold in Summer ; but it is only comparatively so, for the Thermometer stands at the same Height in deep Cellars at both Seasons : This I have commonly observ'd, but in very cold Weather, as for Example, In the Winter of 1709, the Liquor subsided to 18 Degrees, which was two Degrees below *Frost* ; tho' the Air did not

feel cold in the said Cellar, and in a hot Summer it has risen up to 60 Degrees, tho' then it felt cold.

To give a plain Experiment, which any Body may make; Let any one, having one Hand cold, and the other hot, cause lukewarm Water to be pour'd on both his Hands, and it will appear cold to one Hand, and hot to the other; so that we must judge of Heat and Cold as they are agreeable to our Bodies, and not as those Qualities affect insensible Objects. Therefore, tho' by the Thermometer the Air of our Room appears of a sufficient Degree of Heat; yet, if it feels cold to us, we must increase its Heat.

The Reason why Air, otherwise warm, feels cold when blown briskly on any part of the Body, seems to be that by its violent Motion, it beats away those warm Particles about the Surface of the Parts, which causes the Heat of our Bodies by their Motion, or rather stops their Motion by its Pressure, as we may see such an Effect produc'd when we cool hot Coffee by blowing upon it. Now in the Case of the Thermometer, the Glass stops all the gross Air, and only some very fine Particles pass into the Liquor thro' the Glass, and having more Motion than the Parts of the Liquor, cause it to dilate and rise; so when the Hand is blown on, if a Glass
be

be interpos'd between, we no longer feel the Cold; and if our Sense of feeling was nice enough we might feel a Warmth.

After the same Manner, tho' the cold External Air grows warm as it comes thro' the Cavities of the Chimney, yet it must feel cold (when the Fire has not been in long,) as it comes into the Room at R; because not having yet acquir'd a Motion capable of giving us the Sensation of a moderate Heat, it affects us as blowing would do; but then when it is got a little way into the Room, it spreads and loses that Power which it had at first coming out of the Hole, thro' the confin'd Passages of the Chimney: So that unless the People in the Room are, during the lighting of the Fire, so near the Hole R, as to receive the Percussion of the Air, whilst its Direction is still in a right Line, they will not be cooll'd by it. Now, besides this, we are to observe, that this Air drives out the cold Air of the Room as it comes in, and causes the Thermometer to rise.





BOOK I. PART III.

CHAP. I.

Concerning the Make of the Funnel of the Chimney, for increasing and retaining the Heat. The Manner of putting out the Fire, that might catch in the Funnel, in an Instant, and how to make the Room continue warm after the Fire is out. How the Hole of the Funnel at Top of the House must be ordered, that the Heat of a Room may be encreas'd.

THE Winds that often blow down the Funnels of Chimneys into Rooms, should have made Builders take this Matter into Consideration ; for when the Air of a Room comes to be pretty warm, there are at least two Columns in the Chimney, one of rising Smoke, and the other of descending Air ; and tho' the Air does not always descend so violently, as to make little Whirl-winds in the Chimney Corners, or as to blow the Smoke down into the Room, as it often does when the Wind is very high ; yet it

it always comes down fast enough to cool the Room. It is true, such Chimneys very seldom smoke; but then a Fire in them does little Good in very cold Weather. To avoid this Inconveniency, the outward Hole of the Funnel ought to be small, always less than the Bore of the Funnel, and should have several Divisions to cut the Wind. Some have, indeed, streighten'd this Passage, but it has been only to hinder the Room from smoking; in which Case it commonly proves ineffectual, unless with the Contrivance about it, which we shall shew in the next Book.



C H A P. II.

How to put out the Fire in the Funnels of Chimneys in a Moment, and to retain the Heat in a Room all Night long.

OUR new Chimneys, indeed, are less apt to catch Fire than others, because they gather less Soot; but since that may happen thro' Carelessness, we must shew how to remedy such an Inconveniency.

[Fig. 4.] To be able by oneself to put out such a Fire in an Instant, we must have a Register Plate of Iron towards the
Top

Top of the Funnel, so fix'd by two Wires, as either to shut up the Passage wholly, or to leave it open, as you please; and such another towards the Bottom of the Funnel, as we shall shew in their Description in the Third Book.

When the Chimney is on fire, we move the Coals out of the Hearth, and by means of our Wire, pull down both the Register Plates; then the Smoke and Air confined betwixt them, will so press upon the burning Soot, as to put it out quickly.

The Fire in the Funnel might be put out by pulling down only the upper Register Plate; but then the Smoke would come into the Room, till the Fire was out, which, however, might be borne with, rather than run the Hazard of letting the Fire burn long in the Funnel.

If there was no Register Plate at the Bottom of the Funnel, to avoid the Smoke, you should hang a wet Cloth before the Chimney, and, instead of taking out the Coals, throw Water upon them, and then pull down the Register Plate at Top: And, when the Fire of the Funnel is quite out, the Register Plates must be restored to their Vertical Position, that the Smoke may freely come out, when the Fire is again lighted on the Hearth.

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These Register Plates will serve to keep in the warm Air, and keep out the Cold, in the Night-time, by shutting down either of them; but then you must put out all the Coals, but such as do not smoke, if you have a mind to leave any Fire. Another Conveniency will be, that you will hinder the Smoke of another Chimney from being beaten down into your Room.



C H A P. III.

Of what Use the Ash-Hole, and the Instrument to cover the Fire is, in order to preserve the Heat in the Night-time.

IF you have an open Cavity in the middle of the Hearth, towards the Back of the Chimney, about an Inch deep, it will serve to hold the Ashes that fall from the Fire, and those Ashes, at Night, being thrown upon the Coals, the whole Hearth will be kept warm in the Night-time; as also the Cavity under the Hearth (if there is one) through which you may let the Air of the Room circulate, stopping the Passage of the external Air; because we now suppose the Register Plates in an horizontal Position, and in the Morning you will find the

the Room still warm, how cold soever the Weather is. Another Way is, to cover the fore-part of the Chimney, that the cold Air may not come in, or the warm go out, all the Time.

If you use an Instrument of Copper, Brass, or Plate Iron, made like a Box without a Lid, so large as to cover all the Fire, the Wood Coals may be put together, and the Iron Box over it and all the Ashes, and so you will have a little Fire still left in the Morning. Thus the Air of the Room will, in its Circulation, keep the Degree of Heat that it has, or acquire a greater; and taking off the *Cover-Fire* (as the Author calls it) the Fire will be easily blown up in the Morning, by opening the Vent-hole a little.





BOOK II. PART I.

CHAP. I.

Concerning the Advantages of the new Chimneys, in order to hinder the Smoke from blowing into a Room ; the Cause of which, Builders seem not to have understood, because hitherto they could not wholly prevent it. Of Smoke, and the Way to hinder it from beating into a Room, by the Make of the Fore-part of the Chimney. What causes Rooms to smoke ; with some Reflections concerning Air.

THE Causes of the Smoke's being troublesome to us in a Chamber, are two-fold, Internal or External. The Internal Causes, that is those within the Room or Chimney, are, first, void Spaces which are often about the Fire, and are occasioned,

1st. Because the Air being rarified by Heat, leaves several Intervals between its Parts, where the Smoke, meeting with less Resistance than when they are fill'd, takes up the Place where the Air was before.

2^{dly},

2dly, Part of the Air of the Room goes out with the Smoke, and since the Fire is constantly causing fresh Smoke, there will at last be so much Air gone out of the Room, that the External Air will have more Force against the Smoke, than the Air that is left in the Room, and so the Smoke will be driven into the Room.

3dly, The Air goes out of a Room, when a Door is open'd into a warmer Place, and then the Smoke, will come back into the Room, upon account of the diminish'd Pressure. The same will also happen when you open a Door or a Window of any part opposite to that where the Wind blows.

This kind of Void that happens in a Room, is the chief Internal Cause of its smoking, and has not yet been taken notice of, in order to remedy it.

Too great a Quantity of Soot, and gross Air stagnating in the Funnel, when you first light the Fire; the common Make of the Jams and Breast of Chimneys; and the way that most of the Funnel or Flues are carried; are also internal Causes of a Room smoking.

REMARK.

We observ'd in the first Chapter of the Second Part of Book I. That several Experiments

Experiments shew warm Air to be lighter than that which is cold; and therefore there is no doubt, but that Air rarefied by Heat, is specifically lighter than cold Air. Now, some have objected, that when the Air in the Room is warm, as it becomes lighter, its Pressure will be diminish'd, and so the Smoke will easily be driven into the Room; but we must consider, that the Pressure of the Air in the Room, is help'd by that of the whole Atmosphere; and tho' the warm Air in the Room, should weigh but a quarter of what the cold Air did before, yet it cannot take off above a ten thousandth, or twenty thousandth Part of the whole Pressure, as may be seen by the Barometer, which does not sensibly fall, when the Room is very warm; besides, the Air in the Chimney, which takes up a longer part of the Pillar of the Atmosphere, is more rarefied by the Fire. Therefore this cannot be the Cause of a Chimneys smoaking; but the abovemention'd Voids.

The External Causes of Smoke; that is, such as are without the Chamber or the Chimneys, are, 1st. The External Air above the Chimney, which hinders the Smoke from coming out.

2^{dly}, The Wind which not only hinders it from coming out, but beats it back into the Funnel of the Chimney, where they
also

also blow down some times with such Violence, as to drive the Ashes and Coals about the Room.

3dly, The Hole at the Top of the Funnel too large, or too long, for its Breadth.

Air hinders the Smoke from going out at the Top of a Chimney.

1st. When it is too thick for the Smoke to break thro' it.

2dly, When the Chimney is commanded, tho' the Weather be very calm, and the Air clear, because, as the Parts of the Air move every way, the Resistance that they meet with on any one Side, diminishes the Spaces between them, and so both condenses the Air, and encreases its Spring; then, as in the former Case, the Smoke cannot so easily divide the Air to get up thro' it.

The several Cases wherein the Wind keeps back the Smoke, are these:

1st. When Chimneys are commanded on any Side, as when they are near any great Building, near a Steeple, Tower, or a higher House, or the Side of a Mountain, &c. they are used to smoke, tho' the Wind is scarce sensible, especially when it comes from the Side opposite to that which commands them; because the many Stops that it meets with, makes it rest at Top of the Chimney, and even

even drive into it by its encreased Spring, as we see all Fluids go towards those Parts where they are least press'd.

2dly, When the Winds are violent, this Inconveniency is greater, because such Winds not only hinder the Smoke from going out, but make it go back with Violence; for the Air in the Chimney, whatever Wind blows, is always more rarified than the outward Air. Likewise, when the Wind blows very fast, and has a great Degree of Velocity; and if its Horizontal Direction makes it slide over a Chimney's Top, it is because it meets with nothing in its way, just as Water that being forc'd out of a Spring along a Table with Holes in it, passes along such a Table, without falling down the Holes, whilst it has no Resistance before it; but if it meets with any rub, it spreads all round about, and falls thro' the Holes of the Table, and that easier than it would run off on the Sides, by reason of its Weight; now rarified Air, or the Smoke, which is in the Chimney, does that to outward Air, which Gravity did to the Water in the Case just mention'd; that is, when the Wind meets with a rub beyond the Chimney, the Rarefaction of the Air in the Chimney under it, takes off from the push upwards against the Smoke, which a-
E
mounts

mounts to as much as giving it a pressure downwards.

3^{dly}, When a Chimney is near enough to the Place that commands it, and the Wind is strong, it may be made to smoke, tho' the Wind blows from that Part where it is commanded ; because the Opposition that the Wind meets with, encreases the Spring of the Air, and making it to be condens'd in that Place, as soon as it is pass'd over the Obstacle, it pushes downwards into the Chimney, where it meets with least Resistance.

4^{thly}, Tho' a Chimney is not commanded, the Wind may blow into it, especially, if its Hole be a *Parallelogram*, and the Wind runs along its longest Sides ; and indeed in any Position of the Hole, a North Wind, which commonly blows downwards, may beat into it.

Lastly, Too wide a Hole at top of the Funnel ; because the Wind may easily blow into it then. These are Causes of a Room's smoking ; and we shall shew which way these Inconveniencies may be remedied, when we have made it appear, that the Make of common Chimneys causes them to smoke.

C H A P. II.

That parallel Jams or Sides, the Inclination of the Breast or part behind the Mantle-Tree, and the way that the Funnels are carried, occasion Chimneys to Smoke.
[Fig 1.]

IN common Chimneys where the Jams are parallel, the Smoke easily spreads into the Corners $CBA\ cba$, and the least Agitation throws it into the Room.

1st, Because when it is in those Corners, it is less push'd upwards, as being no longer over the Fire.

2^{dly}, Because those Places being less heated, the Air of the Room is not driven so strongly thither, and consequently does not so much push the Smoke.

3^{dly}, Because the Air of the Room striking with more Force upon the middle of the Chimney where the Heat is, it becomes more extended by Rarefaction, and pushing the Smoke still against the Corners of the Chimney, makes it recoil and go back into the Room.

4^{thly}, Because the Air of the Chamber does scarce press the Smoke at all, when it is got under the Chimney-Piece; because of the inclin'd Breast $o\ I r$, where there is

a free and heated Passage, into which it goes freely and dilates it self.

5^{thly}, Because if the Air be driven forcibly into the Chimney, as it happens when a Window or a Door is open ; that Air driving the Smoke violently against the Back of the Chimney, it will be reflected into the Chamber, and if it be driven from thence back into the Chimney, it will whirl about in the Corners, especially if a Wind at the same time blows down the Chimney.

[Fig. 3.] As for the Breast of the Chimney *o I r*, it not only gives Passage to the Air that should drive the Smoke up the Chimney ; but when it is heated, it rarifies the Air in the Space *m i o r*, so much as to make it press less against the ascending Smoke, which therefore strikes near the Slope *o I r*, and being reflected, comes back into the Room ; for it does not observe the same Rules as the Rays of Heat ; and as it beats upon the Surface *o I r*, the greatest part of it is spread every way ; as it happens to rising Liquids that meet with Opposition.

[Fig. 4.] The Smoke is also reflected into the Chamber, when Chimneys have their Funnel drawn on their Wing on one side ; for the Inclination beginning from the Top of the Jam at B, the Smoke DE, which meets with Resistance there, is reflected

reflected and comes down ; and that more than it would do if it struck higher at L ; for the Force diminishes as it goes farther from the Fire ; but how little soever it comes down from striking against E, it comes back into the Room. For Experiment-sake, hold a smoking Cole in the Chimney-corner just under B, and then in the middle under L, and you will see that the Smoke which strikes against E, will go back into the Chamber ; but not when in the last Case it strikes against L.



C H A P. III.

That Jams or Sides bent into a Parabolic Form ; the Horizontal Plane under the Mantle-Tree ; and the Funnels carried in Curve Lines, when they are not carried directly up, are the most proper for hindering Smoke.

Parabolical Jams, and a Funnel whose Wings are bent in a Curve, will take off all the Inconveniences mention'd in the last Chapter.

[Fig. 2 & 6] For, 1st, you take off the Corners *cba* CBA, where the Smoke used to stagnate, and then come back into the Chamber.

2^{dly}, This confines all the Smoke over

E 3 the

the Fire which drives it upwards with Force ; and so it has more Power to resist the Air at Top of the Chimney.

3^{dly}, The Air of the Room presses against the Smoke, whilst it is over the middle of the Fire, and so drives it all at once up the Funnel.

4^{thly}, If any part of the Air that strikes upon the Jams be reflected, it goes to Ff the *Foci* of the Parabolas, and therefore drives the Smoke thither ; where it is carried up by the Action of the Fire.

5^{thly}, As the Air of the Room goes into the Chimney, it meets with a narrower Passage, which makes it encrease its Force ; and much more so, by reason of the great Rarefaction of the Air, which is directly over the Fire: Likewise by reason of the Horizontal Plane oim , the Smoke that would come back into the Room, meets with the whole Stream of Air, and so is push'd up.

6^{thly}, The Air from the Room having gradually more Force as it comes into the Chimney, as soon as it has pass'd m , goes with Violence into the Funnel mLR and, as it goes up, makes a Wind, which forcibly carries up the Smoke.

[Fig. 3.] As for the Horizontal Plane oim , it not only causes the abovemention'd Condensation of the remaining Air, so as to make it act more strongly against the
Smoke

Smoke, but also fills up the Void o M R, which, as we shew'd before, was one of the Causes of a Chimney's smoking; and if any Smoke should escape, and endeavour to go out of the Chimney under it, before it can be got from m to o , it is beaten back by the entring Air, whose Force is greater towards $m i o$, than lower; because the Air being already warm, and that Surface warming it still more, makes it tend upwards, and strongly press against $m i o$, so as to hinder any Smoke from coming out that way.

[Fig. 4.] Lastly, if the Wing be carried in a Curve; as for Example, in the Arc BeH , whose Center is taken upon the Side of the Plane $m i o$ under the Mantle-Tree produced, as at C , you will avoid the Disadvantages owing to the common way of building it in the Line $BELH$.

For, 1st, The Smoke DE , which would have struck against E , will only strike against e , and with less Force, as well because it becomes weaker, by being farther from the Fire, as because the Surface is less inclin'd: Thus if you suppose the Smoke to strike against E , and from it to descend to D , whence it will go into the Room; in this Case, as it does not strike against the Wing till it comes to e , it will only be beaten back to E , and consequently cannot go out of the

Chimney downwards, but will be pushed up by the Air, and the fresh Smoke that comes from the Fire.

2dly, Supposing that only part of the Smoke that strikes against *E*, should go down again, and be reflected as usually, the Reflections will be made to *G*, and so may occasion the Smoke that is below *EG* not to rise so easily; but when it strikes against *e*, it is only reflected to *g*, where it cannot hinder the Smoke that is below it.

You may leave the falling Wing of the Funnel *b p h* as it is commonly inclin'd; but it is better to have it a Curve also, as you may see in the Figure.

That this way of building Chimneys must be a great Means to hinder them from smoking, is plain, from what has been said; but if there should be some Case where it would not be sufficient, the Method that we shall give in the two other Parts of this Book, will fully do it.



C H A P. IV.

Concerning the Vent-Hole, and the way of laying the Wood in the best manner to prevent the Smoke.

TH E Bellows or Vent-Hole mention'd in the *first Part of Book I.* does also prevent Smoke ; not by driving it up the Chimney, as some imagine (for its Direction would only drive it against the Back) but by making the Fire to flame, and so diminishing the Quantity of Smoke (Flame being only burning Smoke :) As also by encreasing the Heat of the Fire, and thereby giving it more Force to drive up the Smoke. If the Vent-Hole be too long, it will throw about the Smoke, more than it encreases the Heat ; therefore we shall give a particular Description of it in the *Third Book.*

If the Wood be round, then all the Care requir'd is to lay it so as the Air may draw easily between to fan the Fire ; but if it be cleft Wood, you must never let the flat Side incline forward towards the Room, but be either perpendicular, or rather inclined towards the Back of the Chimney ; because the Smoke takes its Direction according as it is reflected from the flat Part of the Wood.



BOOK II. PART II.

CHAP. I.

As such a Disposition of the Chimney as we have described in the first Part of this Book, is not sometimes sufficient to hinder the Smoke in close Places; we shall now shew of what Service the Contrivance for the Passage of Air behind the Back is, for hindering Smoke. And that the External Air, which warms a Room by going thro' the Cavities behind the Back, does also hinder it from Smoking.

HAVING before observed, * that the Fire did continually drive out, thro' the Chimney, part of the Air of the Room, and that the most common Cause of a Chimney's smoking, was, that the Air did not come into the Room so fast as it went out of it; if therefore the External Air is let into the Room thro' the Cavities of the Chimney, described in the *Second Chapter of the Second Part of Book I.* there will always succeed new Air

* See Book II. Part II. Chap. I.

Air to that which goes up the Chimney; if therefore we make the Passage for the External Air open enough to let in as great a Quantity of Air as that which goes up the Chimney, the Room will always be kept so full, as to hinder the Smoke from coming into the Room, unless the Wind blows down the Chimney, (and that we shew how to prevent) and so the internal Cause of a Room's smoking, which is the only Cause of Smoke in Places not commanded, will be quite taken off.

It may be said, that if only a fresh Supply of Air be wanting, then opening a Door or a Window will do the Business; this indeed will give Air, but often too much, always cool the Room, and yet often not hinder it from smoking; for if the Door or Window which is opened looks towards a Point opposite to that from whence the Wind blows, then (as we have shew'd before) will the Wind blow down the Chimney, and fill the Room with Smoke, even so as to drive it out at the abovemention'd Door or Window. But the Air that comes in thro' the Cavities behind the Chimney (when there is a Fire) will come into the Room, let the Wind blow from any Point of the Compass, and warm the Room at the same time. It is true, that it comes
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in faster, and therefore in a greater Quantity, when the Wind blows upon the Hole, to admit the External Air, and flower in calm Weather: But if the Cavities are rightly proportion'd, you will not fail of the End propos'd; because when the Wind blows, there ought to come in more Air to overcome the Resistance that the Smoke meets with at the Top of the Funnel; and in still Weather, the Air will come in a sufficient Quantity to overcome the then less Resistance. There is also required a less Supply of fresh Air, when the Funnel of the Chimney is narrow, and you make a less Fire.



CHAP. II.

Of the Bigness of the opening of the Sides and Cavities of the Chimneys, in order to let in as much Air as is necessary to hinder the Smoke.

WHen you would only warm the Room, such Care need not be taken in the Proportion of your Cavities, thro' which it comes into the Room; because all the Inconveniency will only be, that the Room will not be so soon warm'd: But it is not so, when you would prevent Smoke; making the Hollows too big,
would

would, indeed, do no other Hurt but hinder the Room from being so soon warm'd; but then making them too small, would make them useless, because there must come in as much Air as goes out, to act upon the Smoke, which otherwise would certainly come into the Room. But we must not imagine, that the Hole where the Air comes in, ought to be as big as the Bore of the Funnel of the Chimney; for tho' a greater Quantity of Air can pass thro' the Funnel, than thro' the Hole of Communication B. [Fig. 4 & 6] yet as much may come into the Room at B, as the Quantity which goes out at the Funnel; because it may (and indeed does) go faster thro' the one than the other; and if it goes in fifteen times faster, for Example, then it is enough for the Hole R to be put equal to the fifteenth Part of the Hole of the Funnel; nay, and it must be less, for there does not go out thro' the Funnel as much Air as it can contain, because the Smoke goes out along with it. Besides, the faster the Air goes up the Chimney, the more is the Room emptied, and consequently the external Air meeting with less Resistance comes in the faster.

If you would have an Example to prove what I affirm, let it be consider'd,

1st. That

1st. That as much Water shall pass thro' the Arches of a Bridge, as in the whole Channel of the River, tho' those Passages may not be equal to above a third Part of the said Channel.

2^{dly}, That more Water goes out of a Vessel the first Quarter of an Hour, than the Second.

3^{dly}, Tho' you should encrease the Hole of the Vessel during the second Quarter of an Hour, yet there might go out less Water than during the first; because the Water being more press'd, goes out with more Velocity in the first, than in the last; so it is of the Air.

The just Proportion of the Hollows, according to the Bigness of the Chambers, will be given in the Third Book.



C H A P. III.

That the coming in of the External Air, to drive out the Smoke, does not hinder the Rays of Heat from coming into the Room.

IF the Rays of Heat were of the same Nature as Smoke, then indeed the Air would hinder them from coming into the Room; but whereas the Smoke is hardly any thing else but the Moisture of the Wood, reduc'd into a Vapour by the
the

the Heat ; the Rays of Fire are made up of the solid Parts of the Fuel darted with a great Force from the Fire, which easily pass thro' the Air ; and the more so, the more it is rarified : Nay, we know that they will pass thro' Silver, Iron, or Brass. Thus Sounds are hindered by contrary Winds, whilst the Particles of Light are darted to us with the same Force, which way soever the Wind blows.

N.B. Monsieur G A N G E R's Fourth Chapter, recites several ways that have been used, without Success, by several Architects, for preventing Smoke ; and therefore we thought it needless to Translate.





BOOK II. PART III.

CHAP. I.

In some Cases, Chimneys are commanded in such a manner, that besides what we have already mention'd, there must be a particular Disposition of the Top of the Funnel on the outside, which we shall give in this Part; but we must no way neglect the Helps given before; but when Necessity requires, we must make use of them altogether. Concerning the truncated Pyramids, which may be added outwardly to the Hole at Top of the Funnel of Chimneys, to help the Smoke to go out, and hinder the Wind from coming in.

Since a Chimney smokes where it is commanded, we ought, as often as we can, to build them up higher than the Top of all the House.

[Fig. 8.] And because Aa, the Length of the Hole at Top of the Funnel, often gives way for the Wind to blow down the Chimneys, and drive down the Smoke,

we

we must divide the said Hole into several little Squares, whose Contents taken together, are to be equal to the Hole as it was without them : Then a Wind that blows in the Direction *Aa*, will be as much hinder'd from going into the Funnel, as if it had come in a Direction perpendicular to it. But because making the Hole into Squares, will not enough break the Wind ; (for when the Air is in Agitation, it may rest upon the Flats of this divided Hole, and the Compression occasion'd by that Means may force Air down the Chimney ;) therefore we must add square hollow truncated Pyramids, whose Bases are bigger, and upper Holes less, than the square Openings of the Funnel : The Pyramids thus parted at Top, tho' joining at Bottom, will hinder the Wind from blowing into the Chimney, whatever Point it comes from.

1st, Because by cutting and dividing the Wind, they will diminish its Force.

2^{dly}, Because as they are terminated with an Edge, there will be no Horizontal Plane upon which the Air can be compress'd so as to encrease its Spring ; as it happens at Top of those Funnels that have any Flat to resist.

3^{dly}, Because from whatsoever Point the Wind blows, it can find no easy Entrance,

trance, the Top of each Pyramid being very narrow.

4thly, Because tho' some Wind should come in, each Pyramid being narrower at Top than at Bottom, that Wind will grow weaker as it descends, and the Hole of the Square of the Funnel being less than the Base of the hollow Pyramid that covers it, the greatest Part of such Wind will meet with Resistance and be reflected upwards.

5thly, Because the Wind does not equally go into all the Pyramids, and if it should come in at one or two of them, it would easily come out at the others.

The way that I first discovered that the Length of the Hole at Top of the Funnel did sometimes cause Chimnies to smoke, was this; I observed that of two Chimnies in one Apartment which smoked, they never smoked both at the same Time; and found it owing to the Position of the Length of the Holes of the Funnels, the one being perpendicular to the other: For that Chimney did not smoke against which the Wind blowed perpendicular to the Length of its Hole; so by dividing its Hole into Squares, the Wind could only blow in the same manner, as if its Direction was perpendicular to the Length of the Hole, as before. And to prevent the Inconveniency that might happen when

when its Direction is inclined downwards, I added the truncated Pyramid above mentioned, and since I have never been troubled with Smoke. The House indeed is very high, and the Chimney not commanded; but for such Chimnies as are lower than several Buildings about them, if these Pyramids are not sufficient, then apply the Capital which we are going to describe.



CHAP. II.

*Concerning the Capital * to be added to the abovementioned Pyramids, to hinder the Wind from blowing into such Chimnies as are commanded, or too much exposed.*

THE Pyramids mentioned in the foregoing Chapter, are but part of the Contrivance to hinder Smoke; but we have given their Description by itself, because upon Tryal they have succeeded very well; but as some times there may be Cases wherein they don't sufficiently hinder the Wind, one may add above them the triangular Prism $S R Q q r s$, [Fig. 9.] either hollow or solid, as long as the Hole

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of

* The Second Chapter of the Second Part of the Third Book, will make plain what we may seem difficult here.

of the Chimney bearing with one of its Angles Rr upon the middle of the three Holes of the Pyramids, by that means dividing those Holes in half, its Plane $SQsq$ opposite to that Angle, will be parallel to the Squares of the Holes that are Horizontal, and as broad as any of the Holes, that nothing may fall into them that comes down perpendicularly upon that Surface $SQqs$; and above that Prism may also be added, a Capital open at Top, equal in Length to the Prism, and divided into several other little square truncated Pyramids, whose Planes $IHGghi$, $NOPpon$ below the little Pyramids, must be open enough at Bottom to leave a Space on each Side of the Horizontal Plane of the Prism, and long enough to go down below its Angle Rr , that bears upon the first Pyramid, to cover part of them without touching them. I say, that such a Capital will wholly hinder the Wind from going into the Chimney, whatever Situation it has, and from whatever Point it blows; and the Smoke will come out freely. [Fig. 8, 9, 11.]

For, 1st, The Smoke will meet with no Stop but inclined Planes, along which it will slide easily, and so go out freely.

2^{dly}, The Wind which coming Side-wise blows Horizontally, will not go into the upper Pyramids, for the Reason given in

in the foregoing Chapter; neither will it blow into the under ones upon the same Account; and when its Direction is perpendicular to Ll , the Length of the Capital, it may even help the Smoke to go out upwards, by blowing in at the lower Holes; for the lower Pyramid making a Resistance, the Wind will be made to go upwards, where it will carry the Smoke before it.

3dly, The North Winds, and all Winds that blow downwards, and so may enter into the little Pyramids of the Capital, will always find an easier Passage thro' the Sides Gg, Pp open downwards, (and will that way carry the Smoke with them,) than there would be to go into the under Pyramid, whose Holes are covered by the Horizontal Plane of the triangular Prism. The same thing will happen in respect of the Winds which encrease the Spring of the Air, by the Resistance they meet in striking against the Eminences which command the Chimnies; thus no Wind will be able to go into a Chimney that has this Contrivance, neither will the Smoke be hindered from coming out of it.

N.B. Monsieur GAUGER's third Chapter recounts several unsuccessful Contrivances applied to the Tops of the Funnels of Chimnies to prevent their smoking, for which Reason we omit it.

C H A P. IV.

Shews how inconvenient the Smoke is, and how necessary it is to prevent it.

ALL Rooms are not equally apt to smoke, and those that smoke most, smoke not equally at all Times: Sometimes the Smoke is so violently driven into the Room, that the Fire must be put out, it being less troublesome to bear the Cold, than the Smoke. This does not indeed happen in all Apartments; but there are none but what smoke when they are very close; and if you don't bring in warm Air in Winter, you must either suffer the Cold, or the Smoke. Smoke makes the Eyes smart, spoils the Goods in a Room, blackens our Cloaths, and the Ladies Linnen and Lace. Besides these, there are several other Effects of Smoke which are very pernicious: Several People have been killed with Smoke, and the Vapour of Coals, from which that of Wood differs but little. I once had such Experience of it, as had liked to have proved fatal: I had caused a Stove to be made in my Closet in the Country, and having used it but a few Days, did not so readily find the Inconveniences of it; but one Morning the Wind blew into the Flue so forcibly, as to fill

fill my Clofet with Smoke in a Moment, and drove out the Flame thro' the little Vent-Hole; I immediately took out the Wood, and put Charcoal in the Room, and so having less Smoke, I staid two or three Hours longer writing in my Clofet *: as soon as I went out I was taken with such a Giddiness in my Head, Qualms and Fainting, that I easily guessed that if I had staid a longer time in the Clofet, the Consequence of it would have been fatal. Therefore, tho' we may not at first feel the Inconveniency, yet at long run we shall find the pernicious Effects of drawing Smoke into our Lungs or Stomach, or Air impregnated with Smoke.

The Reader may have hitherto observed, that all the means used to prevent Smoke, were the same used for the encreasing of Heat. The Parabolical Jams or Sides; the Cavities behind the Back of the Chimney, for introducing and warming the External Air which

F 4

rushes

* It will not be improper to give an Account of some Experiments to this purpose. If you draw the Air out of the Glass-Receiver of an Air-Pump, and let in Air to fill up that Vacuity in such manner, that it shall pass thro' the Smoke or Flame of Sea-Coal, or Char-Coal, and drive it before it as it rushes into the exhausted Receiver; that Air will be so vitiated, as to kill a Cat in a very little time, if, taking off the Cover of the Receiver, you put the Cat into the Receiver filled with this Air, thus impregnated with the Steams separated from the Sea-Coal or Char-Coal; those of Char-Coal being always found most pernicious,

rushes into the Room; and the Contrivances *In*, and at the *Top* of, the Funnel to keep back the Wind, all tend to *prevent the Smoke*, as well as to *encrease the Heat*; and those that prevent *one*, are properest to prevent *another* ill Effect of the common Chimnies.





BOOK III. PART I.

The Two foregoing Books have only shewn the Use of our New Chimnies, by giving a slight Description of them; but we shall here be very particular, in order to instruct the Workman how to make them easily; and shew the Construction of the Hearth and Jams of the Chimnies, and of the Hollows that must be left behind, as well to increase the Heat, as to hinder the Smoke..

C A H P. I.

Of the Model, by means of which the Workman may give Chimnies that Sweep or Curvature which they ought to have.

WE here suppose the Chimney 4 Feet wide, and 20 Inches deep; tho' we shall also give the Proportion for Models, when the Chimnies are larger or less.

[Fig. 12.] Take a Board AB *ba* 4 Feet long

long and 20 Inches broad, whose Sides are all square to one another; from the Middle *M* of the Side *Bb* mark *MC* eleven Inches, and from *C*, the Length *CG* of 4 Inches, draw the Line *GA*, on which take $GH = 5$ Inches, from *H* draw *HP* square or perpendicular to *GHA*, join *HC*, and upon *I*, the Middle of that Line, draw *IP* perpendicular; then from the Point *P*, where it cuts the Line *HP*, as your Center, with the Distance *PH*, or *PC*, draw the Arc *HC*; then do the like on the other Side, where you have the same Letters in a small Italic Character.

Within an Inch of the Side *BC cb* of the Board, mark the Rectangle *KktT* a Foot long, and 8 Inches broad, its Middle being over-against *M*; and within 3 Inches of *KT*, draw another small Rectangle *Z* 3 Inches long and two and a half broad, whose Middle must be over-against the Middle of *KT*; cut out the Stuff where those Rectangles are drawn, and having also cut the Board away along the Line *AHCM cha*, you will have the Model for the Back and Sides of the Chimney.

We have supposed the Breadth *Aa* of the Chimney to be 4 Feet; but if it was but three and a half, then *CG* should be taken but equal to 3 Inches and a half, and but 3 Inches if *Aa* be only 3 Feet wide,

wide, GH 4 Inches and a half in the first Case, and only 4 in the last.

In all these Cases you may make gb equal to gc , and draw perpendicularly from those two Lines, cp and hp , and about p the Point of their Intersection, with the Distance pc or ph , draw the Arc cb , and do the same thing on the other Side.

If you would have the Sides AHC, ahc , which are nearly parabolical, to be strictly so, then each Side must be a half *Parabola*, having F f for their Focus's; [Fig. 2.] the Back between the Vertex of each being left streight; and any Work-man that can but draw a *Parabola*, may fit the Model, tho' there is no need of being so exact; because, since the whole Design of the Parabolical Jams, being to throw all the Rays of Heat into the Room, the same Effect will be produced by Sides that are nearly so.



C H A P. II.

First Construction for the simple Chimnies,
[Fig. 6.]

1st, **T**HE Model *AHCcha* for the Sweep on the inside of the Chimney, being drawn after the manner shewn in the foregoing Chapter, must be laid on the Hearth, or the Place designed for the Hearth of the Chimney, in such Manner, that the Points *Aa* touch the forepart of the Jams or Sides, which must be raised up along *AHCcha*.

2^{dly}, The lower part of the Breast or Place under the Chimney-Piece, must be an Horizontal Plane, reaching within 10 or 12 Inches of the Back; for the Funnel must be left no bigger, as may be seen in Fig. 3.

[Fig. 4.] 3^{dly}, If the Funnel does not go streight up, the Wings of it *BeH*, *bGb* must be made Parts of a Circle from *B* and *b*, the Top of the Jams, up as high as the Cieling *Hh*, continuing a Line on the Horizontal Plane at Bottom of the Breast, and from a Point taken upon it behind the Back, may be drawn the Arc *BeH*.

These three Positions of the Jams, the Horizontal Plane, and of the Funnel which
must

must also be used in all the other Chimnies of which we shall make mention, are for the first Construction, which, tho' it seems very little to differ from common Chimnies, gives abundantly more Heat without a bigger, nay with a less Fire; as we have shewn in the second and third Chapters of the first Part of the first Book.

[Fig. 6.] You may, if you will add the Ash-Hole *Kkt* T, and the Bellows Z, the Construction of which we shall give in the 10th Chapter.

This first Construction may be effected with very little Expence in all sorts of Chimnies, and very little Trouble or Alteration; but then it encreases the Heat only by reflecting more than common Chimnies; and it would not always be sufficient to prevent Smoke in Rooms that are apt to smoke, tho' it will cure several smoking Chimnies, as we have shewn in the 1st. Chap. Part III. Book II.



C H A P. III.

Second Construction, being that of Chimnies which supply us continually with new Air, which is warmed in passing thro' Cavities behind the Back of the Chimney.

TH E foregoing Construction differs so little from the common way of building Chimnies, that the Workman will find no Difficulty in effecting it; but the same cannot be said of the Construction which we shall give in this, and in the following, Chapters.

To make it the easier, we shall first describe each Piece by it self, and then shew how they must be joyned and laid.

[Fig. 13.] The first Piece*, which is very simple, must be a Plate of Iron or Brass *HI i h* about 4 Feet in Length, and 3 Feet and a half high, made up of several Sheets joyned together.

Now as the Flame continually beats against the Middle of this Plate towards the Bottom, and the Coals always lie against it, you may, in that Place, add a small Plate *ODFIL* of the Shape represented in the Figure, having round about it a little Frame of Iron half an Inch thick

* This first Piece is marked 2d Piece in this Figure.

thick, the whole being screwed with Screws that have their Nuts fixed behind, that you may at any time take off the Plate, and fix another, without altering the Chimney.

The other Pieces are to be little Strips of Plate Iron 5 Inches wide, and about 10 Inches shorter than the Height of the great Plate to which they must be fixed behind, along the Lines HI , CX , $c\alpha$, hi , in such manner, that the first shall begin from the Top, and end 10 Inches above H ; the second must begin at Bottom and come 10 Inches short of the Top; the third must be as the first; and the fourth as the second, as you may see in *Fig. 21*.

[*Fig. 13.*] Sometimes it will be well to have four of the narrow long Plates between H and h ; but now we suppose only two, in order to make the thing the more intelligible, and that it may be the more easily performed by the Workman; for when a Man understands it, and can do it in this simple manner, he may easily go on to a more complexed Construction.

These long Plates being thus fixed, set the Middle M of the Plate over against the Middle M of the Model $AHCMcha$, then bend it round according to the Model in such manner, that lifting the Model up and down in an Horizontal Position, it may fit the Plate (as it stands upright) from
the

the Top to the Bottom; and you will have the second Construction, which you must lay or fix in the following Manner.

The Way of laying or fixing the Second Construction for a Chimney.

Before we lay this Chimney, or the others, whose Constructions we shall give in the following Chapters, there must be made a square Hole, of about a Foot, in the nearest Wall that looks towards the Street, or into a Court-Yard, or any where out of Doors, about the Level of the lower Part of the Floor, or even below that; to this Hole, if Necessity requires, join a Passage, or Canal, thro' which 60 or 70 square Inches of Air may pass; this Canal may be carried in the Wall, or between the Joys under the Floor, or bearing against the Wall in the Room, as shall be thought most convenient to bring the External Air into one of the Cavities behind the Chimney.

If it be thought needful, or most convenient, Air may be brought in at Top of the Funnel of the Chimney, making within it a small Canal, which must be carried down a little way below the Hearth, and so made to turn up into the first Cavity; but then such a Channel must be made when the Chimney is first built

built, otherwise it would be very difficult. The Passage for External Air being made, set upon the Hearth of the Chimney, or on the Place where it is to be, the Model $A H C M c h a$ [Fig. 19.] between the Jams, or the Places where they are to be; the Fore-part $A a$ must be in the same Line as the Chimney-Piece or Fore-part of the Jams; along the Model must be drawn the Stroke $A H C c h a$, on which must stand the great Plate on the inside of the Chimney: Four Inches beyond the first Stroke, or first Line, draw another (where the Cavities are to be) parallel to the first, to be taken in part out of the Wall of the Back if possible, out of which you must dig it to the Height of three Feet and a half; but if the Wall will not allow it, bring forward the Model, so as to leave behind it four Inches over-against the Line $C c$; in that Case also the Jam must be made forwarder in the Room, and, if there be Occasion, the Fore-part of the Funnel may also come forwarder into the Room; you must fill up the Spaces $A H M$, $a h m$, and those that are beyond the second Curve Line $M N$, $m n$, but without stopping up the Passage $D y$, thro' which the Air must go into the Cavities behind the Chimney; then in the Bottom and Sides must be made little Trenches as M , N , n , m , to sink into

G

them

them, the long Plates which are behind the great Piece; and from the Place where the outward Air comes in behind the Chimney, make a little Channel H Z, which ends in a Civity that must be made under the Vent-Hole or Bellows Z, about 12 or 15 Inches from the Back forwards; the Construction of this Vent-Hole is given in the 10th Chapter. This Cavity thus ordered, the Chimney must be laid; that is, the great Plate set upwright in such manner as to fit to the Model all the way on the inside, and the long Plates on the Backside must fit into the Trenches made for that purpose, and there must be four Inches between the great Plate and the Wall: Then all the Places must be close stopped where the Air can go in or out, except the Cavities themselves, and the lower Hole D, and the Hole R or r, which must be left above.

If you find it difficult to fill those Trenches, after the long Plates are got into them, then before you place the whole Piece, fill the Trenches with soft Plaister, or Morter, that the long Plates may, as they are thrust in, be fixed, and that way they will be closed.

The whole Difficulty may be avoided, and several other Conveniences be had, if you shut up those Plates by a great Plate parallel to the first; for then it will make

a sort of a divided Box, which it would be easy to lay and seal; and, if Occasion be, to take it off and carry it to another Place: The manner of doing it easily, may be seen in the sixth Chapter.

If the Cavity behind the Back of the Chimney is not taken in the Wall, it will be proper to nail a great Piece of Plate-Iron at the Top of the great Plate, to shut up the back Space, or to hold the Morter that is laid on to shut it up.

[*Fig. 6.*] The Chimney being thus laid and seal'd, or closed, from whencesoever you take your External Air, you must bring it quite to D, where it will go up into the first Cavity, go down the second, then goes up again thro' the third, out of which it will go into the Chamber thro' the Hole *r*, where there are only 3 Cells. We shewed in the *3d. Chap. of Book I. Part. II.* the Reason of this Course of the Air.

But because the Air sometimes will not acquire a sufficient Degree of Heat by going only thro' 3 Cavities; you may, as we have already shewn, make 5, by adding 2 more long Plates, and placing them as you see in *Fig. 21.* and the Air will go thro' the Cavities, rising in the first, third and fifth, and descending in the second and fourth. There might be 7 Cells, if the Plate behind the first and great Plate, or the Cavities, be continued quite to the

Fore-part of the Chimney; for 10 Inches Distance between each long Plate is sufficient for common Chimnies; but the Cavity must be no less, that there may pass about 40 square Feet of Air; when there is not Room for this Proportion, make the second Cell a little bigger than the first, and the third bigger than the second, and so on.

The Lines which are drawn winding in the 21st. and other Figures, shew the coming in, the Course, and the going out of the Air.

That the Air which is to pass thro' these Cavities may go into the Room but when you would have it, and but in such Quantity as you would have it, there must be sliding Boards, or Doors at the Holes R or r, where it comes into the Room, which may be more or less open as you see fit. You may also let in the Air at those Holes so as to have it hot or cold, or temperate in any degree; as we shall shew in the 9th. Chapter.

If you would burn Wood, the Billets standing upright, as I am told the *Swedes* do, you may make the Chimney an exact *Parabola*, which will be of use where you must have very narrow Chimnies, as in Corners.

C H A P. IV.

Third Construction, *by which the fresh Air which comes constantly into the Room, is heated both behind the Back of the Chimney, and under the Hearth.*

IN the foregoing Construction, the Air is only warm behind the Back and Sides of the Chimney; but it may still acquire much Heat in going under the Hearth.

[Fig. 13. *First Piece.*] To have the first Piece of this third Construction, you must lay the Model (which we suppose rounded and cut thro') upon a Plate of Brass or Iron, a little longer, and a little broader, than it is; then first draw the Curve Line *AHCMchaA*, round about this Model, and then another parallel to it about 3 fourths of an Inch, beyond the first Line, as you see it pointed in the Figure; you must also scribe, or draw, *KktT*, the Place for the Ash-Hole, if you would have one, and a little forward one for the Vent-Hole *z*; those two Places must be cut thro', but the Ash-Hole, if possible, must be sunk an Inch. In the 10th. Chapter we shall give the Construction of the Trap-Door, which must be fixed to the Hole *Z*, where the Wind

is to come in. Lastly, you must fold downwards to a Square all the Part which is beyond *Aa*, and so you will have the first Piece.

[*Fig. 13. Second Piece.*] The second Piece is a Plate of planish'd Brass, or Copper, *ABEG geb a*, as long as the Round of the Back and Sides of the Chimney, that is, in this Case of about 6 Feet, (it might be of Plate-Iron, and only 4 Feet in length, and 3 Feet and a half high; fold the lower Part and the two Sides to a Square a little more than the Breadth of a quarter of an Inch: Set off upon each Side the Heighth *AB ab*, of 2 Feet and 8 Inches each; when the Plate is 6 Feet long, and covers the whole Compass of the Chimney, take off the two little Rectangles *BEG, beg*; in the Middle of this great Plate, put a little Plate, with its Frame, as we said in the foregoing Chapter.

You must also cut out little Plates 5 Inches broad, some 2 Feet and a half, and some about a Foot long, as may be seen in *Fig. 22*, to make Partitions under the second Piece, and below the first; and then you will have all the Pieces fit to finish the Chimney.

To joyn them together, turn the second Piece *GEBAM abeg* upon the Model *AHCM cha*, which you must hold to it in such Manner, as to have its Middle *M* answer to the Middle *M* of the second Piece,

Piece, and then set the Model upon the Stroke $AHCMcba$ of the first Piece; set up the second upon the first about the Model, in such manner, that its Concave Side may every where touch the Convex Part of the Model.

As what is folded along the Line $ACMca$, is but little above a quarter of an Inch, and that which exceeds this Stroke of the Model in the first, is about three quarters of an Inch, there will be almost half an Inch of Stuff exceeding the other Pieces, which you must fold back again, or turn up over the lower end of the second Piece, putting here and there Rivets, and so you will have these 2 Pieces so fast to one another, as to leave no Passage for Air or Smoke, which ought to be taken great care of: When these Pieces are made of several Iron Plates, the Rivets must be very near together; but if they are Brass or Copper Plates, they should be soldered with hard Solder, or at least those that make up the second Piece.

[Fig. 13.] Lastly, You must fix upon the Square behind the second Piece on each Side of the Middle M , 2 Partition-Plates 5 Inches wide, at least 5 Inches distant from M , and the 2 next, 15 Inches distant from it, that there may be 10 Inches between each; fix such Plates under the first Piece that makes the Hearth, which

must joyn to the others in the Shape of a Square, that is in a right Angle. The first and the third of them must go so far, as the Line *Aa*, which is the Fore-part of the Hearth; and the second and the fourth must come as far short of the Top of the second Piece, *viz.* about 10 Inches. If you would have the Course of the Air be longer, it is but adding two more Partition-plates, to have 5 Cells, as in *Fig. 22*; you may have 7 if you will.

The Partition-plates under the Hearth, may be laid parallel to the Back of the Chimney, and lye from one Jam towards the other, as in the *4th* and *23d* Figures. Those likewise behind the Back, may have an horizontal Position, as in *Fig. 23*; which may be more easily done, if the Back be streight, and the Jams parallel, as in common Chimnies; it is more difficult, if the Back and Sides are rounded after our Method given; but that is not the Reason why we don't use them so, (for they might be fix'd along that part of the Back which is streight,) but the perpendicular Situation goes part of its Journey descending, as may be seen in *Fig. 22*, &c. and so is longer in passing thro' the same Number of Cavities.

Tho' those several Positions of the Partition-plates be easy to be understood by a Sight of the Figures; yet it will
be

be best for the Workmen to use themselves first to one Position of them, 'till they can make them easily, or at least to have Models, tho' but of Pastboard.

How to lay the Third Construction for a Chimney.

When you have made the Way for the External Air, after the Manner mentioned in the foregoing Chapter, and have digg'd out the Space in the Back-Wall, you must also dig in the Hearth to the Depth of 4 Inches, and besides that, make Trenches to fit the Partition-plates into; then from the Plane where the External Air comes in under the Hearth, make a small Channel HZ, which must end in the Cavity that belongs to the Vent-Hole Z. The Hollows being thus prepared, lay or fix all the Plates now join'd, in the Manner before shewn.

The Chimney being laid, and made close, and the external Air being brought to the Hole D, it will go winding thro' the Cavities in the Direction represented by the winding Lines, *Fig. 22 and 23.*

What we have said concerning the Hole R or r, for the last Construction, must also be understood of this.

C H A P. V.

Fourth Construction, *whereby the fresh Air coming continually into the Room, acquires Heat behind the Back under the Hearth, and also under the Mantle-Tree, or Fore-part of the Breast.*

BESIDES the Cavities mentioned before, the Air may got thro' another made over the horizontal Plane at the Bottom of the Breast.

[Fig. 13. 1st. and 2^d. Piece] The two first Pieces for this fourth Construction will be drawn, cut, and put together as those of the foregoing, mention'd in the last Chapter; but you must have only 4 Partition-plates behind the second Piece, in the Manner shewn by the prick-ed Lines, HI, CX, *cæ*, *hi*.

[3^d. Piece.] To have the third Piece, lay the Model AHC *cha* upon a Brass or Iron Plate BG *gb*, which is to be about half an Inch forwarder than the Edge Aa; draw along AH a Line BE equal to BE of the second Piece, and at the other End along *ab* another *be* equal to the first; from the Points E and *e*, you must raise two Perpendiculars EG, *eg* upon the Line E*e*, equal to the Lines EG, *eg* of the second Piece; draw a Line from G to *g*, and another from B to *b*, and cut the Piece within half an Inch of the
Stroke

Stroke GEB *beg*, and fold it up square along the Line Ee; you must also fold upwards, what is left beyond the Line Bb, and downwards what is beyond the Line GEB *geb*.

The two first Pieces being join'd, fix upon the Voids BEG, *beg* of the second Piece, this Third, whose Edges BEG, *beg* being folded, will serve to nail along BEG, *beg*.

You might with another Piece folded also square, (tho' it were but of Tin, or very thin Plate-Iron) shut up the Upper and Fore-part of this third Piece, and fix them together with Rivets, to make a small Canal of it; and then fine Mortar might be laid over the Upper and Fore-part of it, which would make it more solid, and cause the Air to be more heated in passing thro' it.

How to lay the Fourth Construction of a Chimney. [Fig. 24.]

You must dig the Cavity in the Back of the Chimney, and in the Hearth, after the Manner that we have shewn in the foregoing Chapter, for the Construction there mentioned; then take away whatever is solid, under the Mantle-Tree, or behind it, if it be low, to make way for the Canal that must be put there; then the Chimney must be laid, as we have shewn

shewn In the foregoing Chapter; you may also fix this square Canal to the Stone or Timber at the Bottom of the Breast; bring in the external Air as far as the Hole D, from whence it will go into all the Cavities, and go in the Direction represented by the winding Line; that is, it will first go up the Cavity HCXI, from whence it will go thro' GQE into the Passage behind the Mantle-Tree (which Passage is taken away in the Figure, the better to represent the Way of the Air) and so go from SEBL, to *sebl*; from which it will go out thro' *geg*, then descend thro' *ihc*, and go under the Hearth; afterwards rise thro' Cc into the middle Cavity cCX ∞ , whence it will go out thro' one of the Holes R or *r*, or if you will, thro' both at once; little Doors are to be fixed to the Holes, to proportion the Quantity of the Air which comes into the Room. We shall give a Description of them in the Ninth Chapter.

[Fig. 13.] Those that would still encrease the Effect of this Chimney, may easily (especially when it is something large) do it by making the Way of the Air longer; one need only put 2 Partition-plates instead of one, in the Space CA, *ca*, and leave a Space of 4 Inches round about the Chimney, and you will have

have 7 Cavities about the Chimney, besides those under the Chimney-Piece, and under the Hearth ; which last may be still divided ; but all this would make the Chimney too complex and chargeable ; the next Construction is much more simple, and gives a sufficient Heat.



CHAP. VI.

The Fifth Construction, which is more simple than the foregoing, where the Air only passes behind the Back of the Chimney, and is heated faster than in the other Constructions.

IT was requir'd for the foregoing Constructions, to have the Pieces of Brass or Copper, but they might be made of Plate-Iron ; but it would be difficult to make them so exact and clever, especially the great Plate *ABGgba* ; such great Plates of Iron are not managed and worked so easily, when they are made of many Pieces ; for one cannot get such large Plates of Iron as one can of Brass or Copper ; and there would be so much Work, that the Cost would be as much as if Copper Plates were us'd.

But it is otherwise in this Fifth Construction ; for it may be made wholly of
Plate

Plate-Iron, and be as exact as if it was of Copper, be much more solid, and last longer; for you may find Plate-Iron much thinner than Plates of Copper, and it will much better bear the Fire.

In this Construction it is not necessary to have Cavities under the Hearth, nor in the Sides of the Chimney, and consequently not to face them (unless you have a mind) with Plate-Iron or Copper; besides, you need not have any Canal under the Mantle-Tree.

To give the external Air sufficient Heat for warming the Room, you are not only to have in the Back of the Chimney a Box or Case, divided within by long Partition-plates, which make up 3 or 5 Cells, having a Communication one with another, which make a Sort of a recurv'd Canal with several Turnings.

Here follows the Description of every Piece, and the Manner of putting them together, for the Benefit of the Workmen.

[*Fig. 28. 1st. Piece.*] The first Piece must be a Piece of strong Plate-Iron 3 Feet, or 3 Feet and a Half high, and at least 2 Feet wide, made of two Plates join'd, (for you can hardly get one Plate of that Bigness) and divided in 2 Places, as you may see in the first Piece of *Fig. 28*, where the prick'd Lines shew where the
the

the Pieces must be join'd, as they also do in the other Figures.

The 2^d. 3^d. 4th. and 5th. Pieces CGg , Efe , LHh , $Mm\alpha$, are 4 little Plates 2 Feet and 3 Inches long apiece, (supposing the first Piece only 3 Feet long) and 5 Inches wide, besides what is left over and above to turn up for joining them together, as is shewn by the prick'd Lines; when those little Breadths are turned up square, let them be fix'd to the fifth Piece along the Lines CG , fE , LH , $M\alpha$, in such Manner, that the Letters in the one, may correspond with the same Letters of the other; these need not be of strong Plates, any more than the following Piece.

Lastly, The sixth Piece must be a Plate $GgX\alpha mc$, 3 Feet 9 Inches long, and 2 Feet wide; its End Cc , $X\alpha$ must be fix'd to the 2 Ends Cc , $X\alpha$ of the first Piece, and to the other Pieces where it is to touch them; but at first you must only fix the second and third to the first, then the sixth; then the fourth and fifth, because that way you won't be hinder'd from rivetting the others: All these Pieces thus united, will make up the Box $CgX\alpha mc$, *Fig. 27.* which is required for this sixth Construction.

The Partition-plates and Cells are here Vertical, but they might be Horizontal, tho'

tho' they are better in the first Situation, for the Reason given in the fourth Chapter.

[Fig. 21.] The first Piece, or Fore-plate, might be made 3 Feet and some Inches wide; then fixing the Partition-plates in the Manner, and at the Distance before given, there will be left on each Side the Breadth CH , ch of about 7 or 8 Inches; at the Sides of the Plate fix two little Plates the whole length, about an Inch wide, or else turn down the Plate it self, in order to make it keep its Figure, and the better to close it when the whole Box is laid, as we shall shew; and by that means you will leave 2 more Cells, which will still give more Heat to the Air; because having a longer Journey to go, it will be longer encompass'd with Heat.

This Box may, if you will, be of cast Iron, if you make it of two Pieces, one of which has all the Partitions, and so join them together with Screws. The second and third Construction may also be of cast Iron, especially when you have but 3 Cells.

How to lay the Box, for the Fifth Construction of a Chimney.

[Fig. 21. and 29.] First of all, lay the Model $ACca$ upon the Hearth, to draw the curve Line $ACca$ and to mark out the

the Ash-Hole $KT tk$, and the Place for the Vent-Hole Z : Then dig in the Wall the depth $CN nc$ of about 5 Inches, and of the same Height as the divided Box; or if the Wall will not allow it, bring forward the Jams, if the Chimney is not deep enough, that you may have behind Cc (the Back of the Chimney) a Cavity $CN nc$ about 5 Inches deep; dig also the Ash-Hole in the Hearth about 2 Inches deep, and quite as far as the Bottom or Back-part Nn of the Cavity made for the Box; bring a little Canal HZ under the Hearth into the Cavity Z , which is under the Vent-Hole or Bellows, then put the Box into the Cavity made in the Back of the Chimney, in such manner, that the Bottom of it Cc may be raised about 2 Inches above the Hearth, and a Space of about half an Inch may be left behind the Box quite to the Top of it, (as you may see in *Fig. 26.*) and go out about Xx , where the little Openings VVV (*Fig. 21.*) must be left; this Piece, thus laid, must be closed every way, except at Bottom, where it must not come beyond the Line Cc drawn upon the Hearth; you must fill up the Sides of the Chimney along $AHCcha$, that it may have the Shape of the Model; fix the little Trap-Door, whose Construction we shall give in the 10th Chapter, over the Cavity Z , and

this Chimney will be finished if you would have but 3 Cells. But if you have made the Fore-part of the Box of the whole Breadth $H C c h$, in order to have 5 Cells, [Fig. 28.] dig out of the Wall also the Cavities $H P N C$, $h p n c$; [Fig. 29.] Give the Plate the Shape of the Model, from H to h , [Fig. 21.] and lay the Box as we shewed; the last Partition-Plate on each Side, together with the Part of the Fore-Plate $C H c h$, which exceeds the Box, with the Surface of the Wall $H P N h p n$ will make the two other Cells, behind which the Heat is not to pass, but only behind the other three.

This Chimney being thus laid and sealed, the Air that is brought from without, in the Manner shewed in the third Chapter, being come as far as $c M$ [Fig. 21.] will go into all the Cavities of the Box $L H E F G$, and go out thro' $G X$, to go into the Room thro' R , when you have only 3 Cells; but if you have 5, the External Air going in at $D y$, will go thro' G, E, H, M , to come into the Room thro' r , as the winding-Line plainly shews; you may let it come into the Room thro' the other Side R , and even thro' both at once; if you would have cold Air also come in at r , you must bring that Air from the Vent-Hole as far as $h a$, and from thence as far as the Hole;

Hole; the pricked Lines in *Fig. 21.* shew the way.

You must, as much as you can, contrive it so, that the External Air does not immediately go into the Box, especially when it has but 3 Cells, but let it wind a little first.

Tho' in this Construction the Air has not so many Windings, as in those mentioned before; yet it acquires as great a Degree of Heat as in the fourth, and a greater than in the second and third; because the Heat that goes behind the Box, warms it on that Side, and the Flame and Fire before; and as the Partition-Plates are between, they are heated at the same time; so that the Air which in the other Constructions receives its Heat only from the Fore-part of the Cavities, is here heated from all Parts, as passing thro' a Canal encompass'd with Heat; and if you suppose that it takes up 8 Moments in going thro' the Cavities in the other Constructions, and only 4 in this, it will here acquire 3 or 4 times more Heat every Instant: So it will here acquire as great a Degree of Heat in 2 Moments, as it does in 4 or 6 in the other Constructions.

If to this Construction you add a Cavity under the Hearth, as in the 3^d and 4th, thro' which you bring the Air, before it goes into the Box, you will increase the

H 2

Heat;

100 FIRES IMPROVED.

Heat ; as also, if you face the Sides of the Chimney with thin Copper, or even with Tin Plates.

Cold Air may be brought in one of these ways, which we shall give in the 9th Chapter.

The fifth Construction is so simple, easy and cheap, that I reckon it will be the most common ; it is that which I make use of at present.



C H A P. VII.

Sixth Construction *for such Chimnies as can have no Cavities behind the Back.*

W Here you cannot dig in the Back-Wall of a Chimney, by reason of its Thinness, or on any other Account ; then you must take the Cavities only in the Sides and under the Hearth ; you may also make a Passage behind, or under the Mantle-Tree.

[Fig. 4] In this sixth Construction you need not make the whole Compass of the Chimney of one Piece, as in the other Constructions ; you may have the Back as before, and only round the Sides according to the Model ; cover those 2 Sides from the Back C c to the Fore-part of the Jams A a, with Copper or Plate-Iron, and leave behind each a void Space 4 Inches deep ;
divide

divide those Spaces each into two, by the Partition-Plates $H I$, $h i$, and with another Partition-Plate $H h$ divide into two the Space under the Hearth, which is supposed to have been digged 4 Inches deep.

Now if the Air begins to come into the Cavities thro' $D A H$, and goes under the Hearth thro' $A H h a$, it will come up thro' $h a b i$, go down again thro' $i h c$, then (if there be no Cavity behind the Mantle-Tree) go into the second Cavity under the Hearth $c h H C$, go up $H C X$, from whence it will go out to go into the Room thro' R , after it has acquired Heat in all the Cavities,

But if there be a Passage behind the Mantle-Tree, after the Air has passed from D thro' the Cavities $H A a h$, $b a i h$, it will go thro' $i g q$ into the Canal $b e s$, $S F B$ under the Mantle-Tree, go down from it thro' $I X C H$, to go into the second Cavity $H C c h$ under the Hearth, then to rise into $c h x$, and so go into the Room thro' r ; the Space $A H I B$ being of no use, may be left full.

You see that this sixth Construction differs little from the first, third or fourth; and so that they may be used singly or combined, according to the Fancy of the Builder, the Make and Situation of the Place, or the Charges that any one will go to.

The Air may be made temperate in this sixth Construction, as well as in the others,



C H A P. VIII.

Seventh Construction for Chimneys in great Halls, or Places to warm several People at once.

THE Constructions given in the foregoing Chapters, are only for the Chimnies of common Chambers, or of Closets ; but for great Halls, and Fire-Places for Colleges, or other publick Societies, we must vary a little from the Proportions before laid down. In the great Chimnies of such large Places, the Wood is burned whole, especially where the Billets or Pieces are but 3 Feet and 8 Inches long, that they may go in quite to the Back of the Chimney, without being cut shorter : In order to make the Model A H C *c h a* [Fig. 12.] you must first make Cc, the Distance of the Sides at the Back of the Chimney, 5 Feet 8 Inches, and the Line A a 7 Feet or something less ; we suppose it here of such a Length, as is fit to determinethe Opening of the Forepart of the Chimney, and the Length of the Mantle-Tree ; the Line A B and *ab* is 2 Feet long, being the Measure of the Depth

Depth of the Chimney, and CG cg each of 5 Inches; the Lines AG ag must be drawn, and GH , gh , must be 7 Inches each; join the two Points C and H by part of a Circle, whose Center and Radius is found in the manner taught in the first Chapter, and you will have *cha* the Stroke or Line of the Model for those great Chimnies; or else, if you would be so exact, you may make the Sides parabolical. The most simple Constructions are always sufficient for these great Chimnies, because the Cavity in the Back being higher and longer than in the common Chimney, it will contain a great Quantity of Air, of which only a small part will go out each Instant; therefore there will always remain a great deal of warm Air, which will also warm the fresh Air that is constantly coming in; besides, the Fire taking up more room, will consequently give greater Heat to the Air in the Cavities, which must be made about 5 Inches deep, and the Passage where the Air comes come in, passes thro', and goes out, must contain about 80 square Inches.

When these Chimnies are built for great Societies, you may, if the Place will allow it, have them in the middle of the Room, setting 2 of them Back to Back, so that there may be Fire on both Sides. The same Cavity may serve behind, be-

ing divided into Cells ; so that a Fire may be in either Chimney, and produce the same Effect ; and when it is in both, it will warm the Room faster, because it gives the Air much more Heat. If there be 2 distinct Rooms in common Apartments, whose Chimnies are Back to Back ; instead of the usual Back, an Arch may be so built, as to have one Cavity common to both, so as to give Heat to either Room, or to both at once, as you shall see fit.



C A H P. IX.

How to make the Air which comes into the Room Temperate, in what Degree of Heat or Cold you please. [Fig. 21. & 24.]

IF you would have the Air that comes into the Holes R or r to be sometimes hot, sometimes cold, and sometimes temperate, by having both come in together, and by that means encrease or diminish the Heat of a Room, without encreasing or diminishing the Fire ; near the Hole R or r, where the hot Air comes into the Room, there must be a Communication with the Passage y, from whence the External Air comes immediately in, before it goes into the Cavities ; and contrive the matter so, that what opens the Passage for

for hot Air to go into the Room, may shut out the cold Air, and so reciprocally; or else sometimes open one, sometimes the other Hole, or what part you will of either. This may be done several ways; here follows the Description of some easy and simple Contrivances for that purpose.

[Fig. 14, 15, 20, 24.] Get two hollow Cylinders, like two round Boxes or Barrels, to turn one within another, the biggest being about a Foot Diameter, and 9 Inches high; make three openings in it, viz. gl , mn , dp , each 5 Inches wide, and 8 Inches high; the Space lm , which is 6 Inches wide, must be left full, as well as nd of 2 Inches, and the remaining part pg : In the least or inner Barrel leave qc open 6 Inches wide, bc and qy full, being of 6 Inches each; let the remaining Part yb be open, and 8 Inches high; between n and d leave a small part butting forward into the Opening qc , that as the little Cylinder turns about, it may stop when the Points q or c , strike against it.

To fix this double Cylinder, place the Opening nm to the way of the warm Air from the Cavities; let pd be open into the Passage for the cold Air, and gl open towards the Chamber, as may be seen in the 20th, 21st, and 24th Figures; now when yq is over against pd , only the warm
Air,

Air, or that which has passed thro' the Cavities of the Chimney, will go into the Room; but if you turn c over against n , nothing but cold Air, or such Air as comes immediately from without Doors, will come into the Room; for the Hole mn thro' which the warm Air came will be stopped; but if the Point c was only brought forward to the middle of the Hole mn , half of pd would be open, then warm and cold Air would go into the Cylinder, which would be mixed as they came out thro' the Hole gl ; if you shut up but a third Part of nm , you thereby only open a third Part of pd , &c.

[Fig. 15, 21, 24.] That you may turn the inner Cylinder easily, at the End o of its Axis, you must fix a kind of an Hand go that may come out in some part of the Chimney-Piece, or any where else in the Room, where you must draw an Arc that shews how far it must turn to open or shut the Holes of the Cylinders, and divide this Arc into Degrees, that as you turn the Hand, you may know whether the Passage is open for the cold or for the warm Air, or for both, and in what Proportion you let them mix as they come into the Room.

[Fig. 14, 15.] If you left full only the Space cb of the little Cylinder equal to dm or np , you might successively shut up the
3 Holes

3 Holes of the great Cylinder, or leave them all 3 open, or leave only as much of pd open as you have of nm shut.

[Fig. 16.] You might even take off part of those 2 Cylinders, and leave only $pdnm$, of the great one, and cb of the little one, as you see in the 16th Figure; then you will not have occasion for so much Room for this Machine, which is as exact, and much simpler than the other.

[Fig. 17. 18.] Join at right Angles, or square to one another, 2 little Frames pd, nm ; the Breath of each of the Holes pd, nm must be of 5 Inches; and the Height, which is represented in fig. 18. of 8 Inches; within the right Angle, at the Angular Point, fix a Shutter cb , which may alternately shut the Frames, which must be so plac'd, that one of the Holes may answer to the Passage of the Air from the Cavities, and the other to the Place where the External Air comes in immediately, as may be seen in the 20th Figure; instead of a Hinge you must have an Axis for the Shutter to play upon, with a Hand fixed to this Axis, by which you may move the Shutter; or if by reason of the Distance from the Axis to the Place where you can come to move the Hand, too great a Space would be described by the End of it, which describes a quarter of a Circle; you may do it with a
Wheel

Wheel on a Pinion made in what Proportion you please, to know at Sight in what manner the Holes are open, and have an Index which takes up but little room.

You may have two Shutters if you will made in such manner as to shut up, or open both Holes; or by fixing them at right Angles, to have one Hole open, when the other is shut; and then loosen them from each other, to make them single Shutters as before.

If both Holes were in the same Plane, one Frame with a Board sliding in a Groove would do.



CHAP. X,

Of the Vent-Hole, or Bellows. [Fig. 13, 21, 24.]

THE Vent-Hole, whose Uses we explained in the foregoing Books, is as convenient, as it is simple. To a little Frame of Copper or Plate-Iron, whose inside is about 3 Inches long, and 2 Inches and a half wide, or to such an Hole made in the Hearth-Plate when there is one, fix with a Hinge a little Trap-Door Z, so that it may shut close; and instead of rabbeting the Frame and Trap-Door, let both be bezelled or floaped, that no
Ashes

Ashes may lie on the Edge of the Frame, which would hinder it from shutting close: on that Side which is opposite to the Hinge have a little Button that you may lift up with the Tongs; and if you will, the Button may have a Bolt fixed to the under Side of it, to open when you turn the Button; at the under Side of this Trap-Door, on each Side have a small Portion of a Circle, or a Sector, whose Center is at that Part of the Trap-Door, where the Hinge is, that when you lift it up, the Wind may only blow directly upon the Fire; and that the Trap-Door may stand open at such an Height as you think fit, fix a couple of Springs under the Frame, each of which must bear against the Limbs of the Sector-Pieces, and so keep the Trap-Door fast at any Opening: This Trap-Door is represented under the 17th *fig.* When the Hearth is not covered with a Plate, Hooks or Staples must be fixed to the Frame, in order to fasten and seal it close over the Hole made about 12 or 15 Inches forwarder than the Back of the Chimney for that purpose, and into which the External Air comes in at a little Canal, as *bz.*



BOOK III. PART II.

How to order the upper Part of the Funnel of the Chimnies, to hinder the Smoke, to increase the Heat, and to be able to put out the Fire in the Funnel.

HAVING in the foregoing Book mentioned the Contrivances at the Top of the Chimnies, we shall here fully describe them. And in order to apply them more easily, care must be taken in such Chimnies as are built New, to carry the Tops of their Funnels, so as to have their Sides touch in a Stack of Chimnies, that it may rather make a Parallelogram than a Square at Top: When there is occasion for the second Construction, it will readily be fixed to such Chimnies. If we would do without it, we must take care that the Chimnies be built so as not to be commanded.

C H A P.

C H A P. I.

*Of the first Construction applied outwardly
to the Top of the Funnel.*

TH E first Construction may perhaps not appear new, because several Chimnies have something like it; but since it is not universal, nor made in that just Proportion as it ought to have, and especially because it is part of the second Construction, we must give it here.

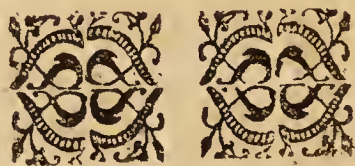
[Fig. 8.] Then supposing Aa , the Length of the Hole at Top of the Funnel, to be 30 Inches in the Clear, that is, on the inside, and its Breadth AB 10 Inches; shut in 2 Inches of it round about, in such manner, that it may open sloping within the Funnel, and thus your Hole will be but 26 Inches long, and 6 wide; divide that Length in CD ; cd , by 2 Partitions of 4 Inches each, whose under-side must end in an Angle within the Funnel, and there will be left 3 Holes, each 6 Inches square.

Make 3 truncated Pyramids, square and hollow, whose Bases in the inside must be 11 or 12 Inches square, and the Top 5 or 6; you must divide each of the Holes at Top into two, by a Partition 2 or 3 Inches deep; but every Hole must not be divided the same way, the pricked Lines
in

in the Pyramids A E G D, DIM D, *dega* whose Height is 12 or 13 Inches; lay and fix these 3 Pyramids near one another; over the Holes ABCD, DC *cd*, *dcba* of the Funnel of the Chimney, in such manner, that the Letters of the Bases may answer to the same Letters at the Top of the Funnel, the Line BA in the one, lying on the Line BA in the other, &c. This will be sufficient for most Chimnies; but when it happens not to have the desired Effect, you must make use of the second Construction, or rather finish the second Construction, of which this is but part.

If the Hole of the Chimney is less then we suppose, diminish the Holes of the Pyramids; and if it be bigger, increase them, or instead of 3 make use of 4.

These Pyramids may be made of Plaster or Potter's Clay, baked like Earthen-Ware; or else you may make use of Tin, especially when you would use the Capital, which we shall describe in the next Chapter.



C H A P. II.

Of the second Construction at the Tops of the Funnels of Chimnies.

[Fig. 33.] **T**H E Pyramids being made and fixed after the manner that we have mentioned, add the Capital, whose particular Pieces are as follows.

[Fig. 10.] The first and second Piece are 2 Boards A H L M O B, *a b l m o b*, (all the Lines marked in these 2 Pieces with the same Letters will be equal, and so it is enough to determine them in the one ; or indeed when you have drawn and cut one, you may easily cut the other by it, by laying the first on to scribe it ;) the Breadth of A B at Bottom must be about 13 or 14 Inches, as well as G B ; the Height A G or B P, 8 Inches ; G H or P O 6 Inches, as well as H I and O N ; the Breadths H O and I N, 12 Inches ; I L and N M, 8 Inches each, and L M, 5 : Q R S is a Triangle where the Wood must be cut out ; its Basis Q S in the same Line as I N is 6 Inches ; and the 2 Sides Q R, R S, 7 Inches each ; A F E B shews the Place which must answer over against the Face A E F B of the Pyramid A E G D, when the Pieces [Fig. 8.] of the Capital are put together and fixed upon the Chimney.

[Fig. 10.] The third Piece S R Q *q r s*
I must

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must be a Plate of Tin 30 Inches long and 14 broad, which you must fold in the middle along the prick'd Line *Rr*, to make a sort of a Gutter, or a triangular Prism, if you cover the upper part of it.

The fourth Piece *GLlg*, and the fifth Piece *FMmp*, must be 2 other Plates of Tin, each 32 Inches long, and 20 broad, indented along their Length, as you may see in the Figures, in such manner that *LT*, *UX*, *YZ*, &c. shall be 5 Inches each, and the Lines *TI*, *IU*, &c. 7 Inches each; the pricked Lines *Hh*, *Ii*, *Oo*, *Nn*, mark the Places where these Pieces must be folded, when you nail them upon the 2 first; they are made of Tin as well as the third, rather than of thin Plate-Iron that is only black, because the Rain will cause such a Rust as will quickly eat thro' it.

To join all these Pieces together, set up perpendicularly the first Pieces one over against another; and at 30 Inches Distance one from another, that is at a Distance equal to the Length of the Hole of the Chimney; in these 2 Pieces fix the third by its Ends, which you must thrust into the Triangular Holes *QRS*, *qrs*, folding it as far as the Hole requires; then you may join also to them the fourth and fifth Pieces, folding them as much as is necessary to have their Ends *GHIL*, *ghil*,
PONM

PONM, *ponm*, rest upon the Edges of the 2 first, beginning from G P, *gp*, [Fig. 8, 9.]

All these Pieces being thus joined together, you must fix them above the 3 Pyramids, in such manner, that the Line R *r* of the Piece which is a Triangular Prism, may lie over the middle of the upper Hole of the 3 Pyramids, which need not be divided here : The Ends A B *ab*, of the 2 first Pieces, are to rest upon the 2 Sides A B *ab* of the Funnel of the Chimney ; fasten and seal the Hole very well when it is in this Situation, and you will have the second Construction.

If you would not make the 2 first Pieces of Wood, for fear of Fire, or wearing out too soon, make only the Model of Wood, that by means of it, you may on each Side raise a Wing of Plaister upon A B *ab*, and so fix and seal on the Sides, and in the Middle, the third, fourth and fifth Pieces in the manner that we directed to fix them to the Wood.

If you had rather make the Hole of Tin, as well as the truncated Pyramids, you may carry the whole Machine ready fitted to the Top of the Chimney, where you may fix it without any Trouble, and be sure that it is tight.

C H A P. III.

Of the Construction of the inside of the Funnels of Chimnies, in order to put out the Fire that might catch there, to keep in the Heat in a Room all Night long, and to hinder the Smoke of a Neighbouring Chimney from coming in; and also concerning the Instrument for covering the Fire.

THE Register Plates for putting out the Fire in the Funnels of Chimnies, keeping the Room warm all Night, and hindering the Smoke of a Neighbouring Chimney from coming into yours, which often happens when your own Fire is out; and the Cover-Fire Instruments, are of such common Use, that what we have said of them in the *first Book* might suffice; but that we may not be wanting in our Directions to the Workmen, we will here describe them more particularly.

[Fig. 5, & 7, 25.] Two thin Plates of Iron *ST ts*, [Fig. 5, 25.] *NO on*, fig. 7. exactly as long and as broad as the Hole of the Funnel of the Chimney is where you design to have them, are sufficient for the inside of the Chimney.

The first Plate *ST ts* must have in the Middle of its Breadth a small Axis at *p P*, whose 2 Ends at *P p* must stand out about
an

an Inch or two ; and there must be two Wires $U M$, $u m$, fixed to the middle of those 2 Ends $U u$, that you may keep it in what Situation you think fit.

[Fig. 7.] The second Plate $N O o n$ must have its Axis $N O$, or $N n$ at its Ends $N n$ or $N O$, and a stiff Iron Wire $I H$ fixed to the Middle I , to put it up or down as you see fit.

[Fig. 5, or 25.] To fix the first Register Plate, in 2 opposite Places of the Funnel within 2 Feet of its Hole at Top, make 2 Holes $P p$ [Fig. 4.] over-against one another ; in the Middle of the Breadth of the fore and back-part, put in 2 Iron Eyes for the Ends of the Axis to play in, and make 2 Ledges in the Chimney, in such manner, that the Plate may go no further when it shuts close ; bring the Wires $U M$ $u m$ down the Funnel into the Chamber, where they must be fastened that you may easily come at them, to open or shut the Register Plate.

Instead of little Ledges in the Funnel to keep the Register Plate tight, when it is brought down to a level Position, you may make it a little longer than the Hole of the Chimney, and then it will be close shut, before it be brought quite down to an Horizontal Position.

[Fig. 7 & 26.] To fix the second Register Plate $N O o n$, you must also make 2
I 3
Holes

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Holes in the 2 Corners of the lower-part of the Funnel of the Chimney, to let in the 2 Ends of the Axis *Nn*, or *N* and *O*, according to the easiest way of opening it; the best way being to have it play upon *N* and *O* let into the Corners, that when it is open, it may be flat to the Chimney, where the stiff Wire or long Hook *HI*, will keep it, by putting the End of the Hook in an Eye at *H*.

As to the Fire-Cover, which may be of Copper, Brass, Plate-Iron or Tin, it is shaped like a Box without a Cover, about 2 Feet long, 10 Inches wide, and 6 deep, with a Loop to move it easily: If it be of Tin, the Plates must be rivetted as well as foldered, or else the Fire would soon make them fall from each other.

The 2 Register Plates being fitted within the Chimney, if the Chimney should be on Fire, take the Coals out of the Hearth, and shut down the 2 Register Plates, as we have shewn, by pulling the Wire *M U*, (*Fig. 4* and *8.*) of the upper Plate, which serves for that Use; and the Hook *I H* (*Fig. 26.*) of the lower Plate, and the Fire will go out immediately; it would go out tho' you should shut down but one of the Register Plates, but not so soon; and then you would be troubled with the Smoke till the Fire was quite out, tho' you might, to avoid that, throw
Water

Water upon the Fire in the Hearth, whose Vapour would help to quench the Fire in the Funnel, and shut up the fore-part of the Chimney with a wet Cloath, or any thing else ; but if you have two Register Plates, the best way is to shut them both down.

By shutting down the upper Register Plate, you will keep out the Smoke of a Neighbouring Chimney, which is often blown down yours when you have no Fire ; by this means you may keep the Warmth in your Room all Night, but then take care either wholly to put out your Fire, or at least to have no smoking Coals.

If you rake up the Fire together on the Hearth, and put the Cover over it, so that no Air comes under it, the Fire will soon be put out ; but if you would keep in the Fire all Night, cover the burning Coals with the Ashes, and put what Wood is left unburned over them, and lay on the Cover so that a little Air may go under it, then the Fire will be kept in without consuming much : In such a Case, the best way is to let down neither of the Register Plates, but to cover the fore-part of the Chimney to keep *out* the cold Air, and keep *in* the warm.



BOOK III. PART III.

CHAP. I.

Of the Effects and Properties of the New Chimnies, and how to make use of them.

N. B. It is not enough for the Workmen to be able to make all the above-mentioned Works, unless they also know the Use of them, which will be a means to make them the more perfect, and enable them to give an Account of their Advantages to those Gentlemen whom they make them for. And we must be obliged to repeat something of what we said in the *First* and *Second* Books.

BY means of our *New Chimnies* you may, 1st. Kindle a Fire very soon; see it always flame, without being obliged to blow it; and without confining your self to the Use of small Wood, make use of the biggest Billets, and even green Wood. See the 4th Chapter. of Book 1 Part 1.

2dly.

2dly. Warm a great Room with a little Fire in a little time, and sometimes the next Room to it. *Chapter. 2 and 3, Book 1 Part 2.*

3dly. Encrease or diminish the Heat of a Room, without encreasing or diminishing the Fire. *Chapter. 3. Book 1. Part 2.*

4thly. Warm your self on all Sides at once, without burning your Legs, Eyes or Face ; and so avoiding all the Inconveniences that attend very cold Weather. *See the same Chapter.*

5thly. Hinder the cold Air from coming in under Doors or thro' Crannies ; and make that little which may come in, be thoroughly warm before it comes to you, if you are at ever so small a Distance from the Windows or Doors where it comes in. *The same Chapter.*

6thly. Bring warm Air upon your self at any Distance from the Fire, without being obliged to go near it. *The same Chapter.*

7thly. Warm your Bed even whilst you are in it, without any Danger of burning you ; and cause warm Air to be blown upon any Part, so as to keep it warm. *The same Chapter.*

8thly. Constantly breath fresh Air, of what Degree of Heat you please ; so as not to dry or offend your Lungs. *The same Chapter.*

9thly.

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9^{thly}. Drive all the Air out of a Room in a little time, and cause it to be succeeded by new Air heated to any Degree in the coldest Season, and dried in the moistest; and thereby prevent the Inconveniences and Unwholsomness of stagnating and vitiated Air, such as is commonly in a Room where any Body is sick. *The same Chapter, and Chap. 4.*

10^{thly}. Have your Room so dry, that your Goods will not be damaged, during the greatest Fogs, or when it thaws ever so fast. *The same Chapter.*

11^{thly}. Keep a Room warm all Night, tho' the Fire is put out. *Chapter. 1, 2, 3. Book 2, Part 3.*

12^{thly}. Never be troubled with Smoke, which offends the Eyes, causes Distempers, and spoils your Linnen, &c. *Book 2.*

13^{thly}, By your self, and in an Instant, put out the Fire that may chance to catch in the Funnel of your Chimney. *Chapter 2. Book 1. Part. 3.*

14^{thly}, Hinder the Smoke of a Neighbouring Chimney from blowing down into yours. *The same Chapter.*

And Lastly, make several Chymical Operations.

C H A P. II.

How to make use of the New Chimnies

[Fig. 6, & 24.] **T**O kindle the Fire in these Chimnies, take a lighted Charcoal, or a Piece of Paper, and setting it between 2 or 3 Sticks, open the Bellows, and all the Wood will quickly be on Fire.

As the Bellows or Vent-Hole blows so much the stronger, as there comes less Air into the Room otherwise; when the Wind does not blow, or the Weather is not very cold, you may shut up the other Passages where the Air comes in; that is, if the Room does not smoke, otherwise it would be better to leave them open, and wait a little longer for the burning of the Fire.

[Fig. 6, 21, 24.] When the Weather is very cold, the Wind comes always violently into the Hole R, which opens into the Room; so that before the Cavities of the Chimney be warmed, it comes in very cold, therefore you must shut up R at first, unless by so doing, the Room should smoke: And in that case you must take care to make the Flame strike against the Back, so as to warm the Plate in the second, third and fourth Constructions, and likewise to cause it to pass underneath,
and

and so behind in the fifth, that the Air in the Cavities may be soon warmed; and to hasten this, you might shut up part of the Hole D, thro' which the External Air comes into the Cavities; for the less of it comes in, the faster it will be heated; but you must always let in enough to hinder the Smoke: And if the Room did not smoke (as it will happen to most Chimnies, especially at certain Seasons) tho' the Hole for the External Air should be wholly shut, it would be well to leave it so for a while, till the Cavities behind the Back were heated. After any one has made use of these Chimnies a little while, Experience will teach the Management of them much better than all the Instructions I can give.

When you find the Room warm enough, and you would not have the Heat encrease any more, tho' you are unwilling to lessen your Fire, you must shut up the Hole R, [Fig. 6, 21. 24.] where the warm Air comes in; and if you would have the Heat diminish, open *pd* the Entrance for cold Air, and shut *nm*; if you would give the Air that comes in, different Degrees of Heat or Cold, leave part of each Passage open, more or less as you see fit.

When you put out the Fire at Night, or in the Day-time, always take care (especially when the Weather is very cold) to

to shut up D, where the External Air comes in, for otherwise the Room would quickly be cold ; nay it will be proper during the whole Night to let the Forepart of the Chimney be wholly shut up ; or if the Coals smoke no more, it will be enough to shut down one of the Register Plates, if you have any, that no cold Air may come in that way, whilst the hot Air goes out.

Now as the Hole R, where the External Air comes in after it has acquired Heat in the Cavities, must be big enough to supply as much Air as will hinder the Room from smoking ; you may shut all the other Places where Air might come into the Room, as well about the Doors as the Windows ; and that as small a Quantity as may be, may go in when the Door is opened or shut, it will be proper to have a double Door, one of which must be always shut before you open the other ; but this is only necessary in very severe Winters, tho' it is always useful.

If you cannot have a Vent-Hole, or will not always make use of it to light your Fire, you must have a Pair of Bellows that blow constantly, whose Description I shall not give from Monsieur Gauger ; because they are become very common, and may be had at several Bellows-Makers, being made according to
Captain

Captain Savery's Method, which is better than the Author's Way.

CONCLUSION.

If what has been advanced in this *Treatise*, shall bring these *New Chimnies* into vogue; and lessen mere *Speculative Enquiries* by promoting *useful Mechanics*, it will then have had its desired Success.



An Explanation of the Figures.

THE Figures 1, 2, 5, 7, 12, 13, 14, 15, 16, 17, 18. need no other Explanation, then what is given in the Chapters, where they are referred to.

The *Third Fig.* represents the Profil of a Chimney, cut by a Plane perpendicular to the Hearth and to the Back.

Z, is the Trap-Door of the Vent-Hole or Bellows; and $\propto$ its opening when it blows.

F, the Place where the Fire is.

T t, the Ash-Hole, and below it the Cavity under the Hearth.

S G A, the Cavity behind the Back of the Chimney.

o i m, the Horizontal Plane under the Mantle-Tree, as we would have it.

I, the Cavity or Passage under the Mantle-Tree.

m L N R, The Funnel of the Chimney.

o R, the Line which denotes the Slope of the Breast, where the Space *o m R* is wholly void, as in common Chimnies.

The Upper-Part of the *Fourth Fig.* is the Profil of the Funnel of the Chimney, with the Pyramids and Capital above them, and the Register Plate within; the Section being made by a Plane passing thro' the Axis of the Prism *R r*.

The *Sixth Fig.* represents a Chimney quite finished, whose Sides or Jams are parabolical.

A H C c h a A, is the Hearth.

Z, the Vent-Hole with its Frame.

K T k t, the Ash-Hole.

O D F I L, the Back with the thick strong Plate framed in before the thin Plate, to hinder the Wood from burning the thin Plate, when there is a Cavity behind the Back for the passing of Air.

D d, the Door for the Air to go into the Cavities.

R r, the Doors of the Holes where it must come out again.

g, the little Hand to turn the Cylinder or Shutter, which opens or shuts the Air's Passage.

P, a Paper hanging by a Thread before the Hole *r*.

The

The *Eighth Fig.* represents the Upper-Part of the Funnel of the Chimney, with its 3 Pyramids above, whose lower Parts we have left uncovered, to shew the Holes of the Funnel.

T t s S, in the Register Plate, which must be fixed so as to play in the Place where it is drawn, in order to put out the Fire that might catch in the Funnel; *P p*, are the Pivots upon which it turns; *V M*, *vm*, part of the Wires which serve to open and shut it; it is here represented shut, but the pricked Lines represent it opened. The fore-part of the Funnel has been left open, to shew this Plate.

The *Ninth Fig.* is the Capital, which it is sometimes needful to fix above the 3 Pyramids; it must be so fixed as to rest upon the Upper-Part of the Funnel of the Chimney, *A B* of the Capital lying upon *A B* of the Funnel, and *ab* upon *ab*, the Surface *H G g h* covering part of the Pyramids, and the Line *R r*, resting on the Top of the Holes of the Pyramids.

The *Tenth Fig.* shews all the Pieces of the Capital by themselves.

The *Eleventh Fig.* is a Profil of the Upper-Part of the Funnel, of the Pyramids, and of the Capital; all cut by a Plane perpendicular to the Thickness of the Funnel, or to the Axis of the Prism *S Q R*.

P *p*, in the Funnel are the Holes where the Centers or Ends of the Axis of the Register-Plate must play.

A F F B, is one of the Pyramids.

Q R S, the Section of the Prism above them.

G H I L M N O P, the Section of the Capital which covers them.

In this Profil you may see how easily the Smoke can come out of the Chimney, and how hard it is for the Wind to blow down into it.

The *Nineteenth Fig.* is the Geometrical Plan of the fourth Consturction of the Chimney, which is represented by the *Twenty-fourth Fig.*

A H C *c b a*, is the Hearth.

Z, the Cavity under the Vent-Hole or Bellows.

H Z, the Canal or Passage for the Air to come into it.

K T *k t*, the Ash-Hole.

H M, C N *c n, b m*, the lowerend of the Partition Plates, which part the Cavities.

H M C N, C N *n c, n c m b*, the Bases of the 3 Cavities behind the Sides and Back of the Chimney.

D *y*, the Channel for the Air to come into the first Cavity.

The *Twentieth Fig.* is an Horizontal Section of the same Chimney, immediately under the Mantle-Tree.

Bb , is the lower Edge of the Mantle-Tree.

$BEeb$, the Lower-part of the Passage under the Mantle-Tree.

$EXxe$, the Hole of the Funnel of the Chimney.

dpI , the Passage for the Air to get up under the Mantle-Tree.

dpi , the Passage for the Air to come down from it.

$XOox$, the Upper-part of the Cavity where it comes up behind the Back.

XOm, xom , the Lower-part of the Ways of it into the Room.

$mnlg$, the Basis of the Cylinders thro' which the Air comes in.

mpn , the Square with the Shutter, which serves for the same Purpose on the other Side.

XO, xo , the Upper-part of the Partition-Plates.

If you suppose this Plan over the former, (*viz.* the 19th *Fig.*) you will have the Chimney as it is, and as you see it in the 24th *Figure*.

The *Twenty-first Fig.* shews the fifth Construction of a Chimney, with the Fore-part of the Back taken off from H to b , as also the Middle-part of the Mantle-Tree, and the Bottom of the Breast, to shew all the Back-part of the Chimney within, or the inside of the Box of cast Iron,

Iron, where the Air passes winding as the double Lines shew.

A H C c b a, is the Hearth.

Z, the Vent-Hole with its Frame.

H Z, the Passage from the Air to come to it.

Z a b p, the Passage to carry the Air up to the Cylinder.

C G g, F E e, H b L, x m M, the Partition Plates fix'd to the Back-part of the Box.

The Line C T t c, shews the Height that the Box must be plac'd above the Hearth, and N l n the prick'd Line beyond, shews the Space that must be between the Back of the Box and the Back of the Chimney; but you may see it better express'd in the 26th *Fig.*

v v v, the Holes where the Air and Heat go out from behind the Box.

g l m n, is the Cylinder thro' which the Air goes into the Room, which may be placed on the other Side, as well as where it is represented, as it suits best with other Conveniencies.

The winding Lines in the *Twenty-second* and *Twenty-third Figures*, shew the way of the Air in different Constructions of Chimnies.

The *Twenty-fourth Fig.* represents the 4th Construction of a Chimney, the Plate of the Back being taken off from H l to b i,

to shew the Partition-Plates, and the Passage which they make behind the Plate and the Way of the Air represented by the white Lines. The Mantle-Tree is also taken off from B to *b*, and the Canal or Passage behind it from E L to *e l*, to shew the inside behind the Back, and the Way of the Air from without Doors, round thro' all the Cavities into the Room.

A H C *c b a*, is the Hearth hollow underneath.

Z, the Vent-Hole or Bellows.

K T *t k*, the Ash-Hole.

A B I H, *a b i b*, part of each Side.

H I X C, C X *x c*, *c x i b*, the 3 Cavities of the Bottom and Sides laid open.

X O N C *x o n c*, the 2 Partition-Plates which divide the Cavity into 3 Cells.

B E S L, *b e s l*, the 2 Sections of the Passage under the Mantle-Tree.

l m n g, the Upper-part of the Cylinders.

m n, the Hole where the warm Air comes in ; *p d*, that where the cold Air comes in ; and *g l* is the Passage of the Air into the Room thro' R.

D, the Hole thro' which the Air goes into the first Cavity.

The Arrows shew where the Air goes upwards, or downwards, or horizontally ; so that which is above I, shews, that the Air in that Place goes out of the first Cavity

vity into the Mantle-Tree Canal, to go towards the other End of it *i*, where the other little Arrow shews that it goes in again in that Place to come out between *g* and *q*, and go down the Cavity *i x c*, as the Arrow there points; and then under the Hearth, whence it comes up the middle Cavity, and at last goes quite out to the right Hand, or to the Left, or both Ways at once.

The *Twenty-sixth Fig.* is the Profil of the 5th Construction of a Chimney, cut by a Plane perpendicular to the Hearth and Back.

Z, the Bellows, $\times$ its Opening.

K T, the Ash-Hole.

L T V, the Thickness of the Box, behind which you may know what Space ought to be left.

I C the Register Plate at the Entrance of the Funnel, and H I, its Hook which keeps it up.

o i m, the horizontal Plane under the Mantle-Tree.

The *Twenty-seventh Fig.* represents the cast Iron Box for the 5th Construction, the Fore-part being taken off, to shew the Cavities and Partitions.

The *Twenty-eighth Fig.* shews all the Pieces of the Box.

The *Twenty-ninth Fig.* is the Geometrical Plan of the 5th Construction.

A H C c b a, is the Hearth which is not hollow underneath.

Z, the Bellows.

H Z, the Passage for the Air to it.

C N n c, the Hollow to place the Iron Box in. The Distance between N n and the prick'd Line, shews the Space that must be left behind the Case when it is laid.

H P N C, b p n c, are the Bases of the two last Cells when there are five.

Some Observations. By Dr. *Desaguliers*.

MONsieur GAUGER having directed us to use Plates of Iron, Brass or Copper, to line the Chimnies, and make the Cavities behind them; I had a mind to know whether the External Air which warm'd it self in rushing through those heated Cavities, did not bring along with it unwholesome Particles of the Metal into the Room: For that Reason I got three Cubes of the three different Metals, one of Iron, another of Copper, and another of Brass, each of them weighing 5 Pounds. I drill'd an Hole into the middle of each of them, about an Inch and an half deep, and a quarter of an Inch in Diameter, as is represented by *h o*: (*Plat. 4. Fig. 30.*) Then having exhausted the Glass Receiver of an Air Pump of its Air, I took the Iron Cube (which had been heated by blowing under it in a Charcoal Fire, so

as

as to look almost white,) and setting it upon a Brick B *b*, I thrust the End *b* of the Pipe that came from the top of the Receiver R into the Hole *b o*, then turning the Cock C which opens into the Receiver thro' the Brass Plate P *p* that covers it, all the Air which came into the exhausted Receiver to fill it again, ran first into the Hole *b* by the Sides of the Pipe C T *b*, till it got to *o*, where coming into the Pipe, it went along *b T C* into the Receiver, carrying along with it the Steams of the Iron, till the whole Receiver was fill'd with this burn'd Air. Immediately I lifted up the Plate P *p*, and putting a Bird into the Receiver, I shut it up again, and the Bird liv'd there half an Hour, without the least sign of being sick : Then making the same Experiment with the Copper Cube, a Bird was likewise unhurt in Air burn'd by that Means, and impregnated with the Steams of the Copper. But when I heated the Brass Cube till its Corners began to melt, and made the same Experiment with it, the Bird began to have Convulsions in half a Minute, and in half a Minute more died.

N. B. The Pipe was of Brass, only the end of it from T to *b* was of Iron, lest the Heat of the Cube should melt it, A *a* is the Plate of the Air-Pump upon which the Receiver stood. The Birds were

Linnets, but the same Bird was not put in twice.

I made the Experiment a second time with the Brass Cube, without having blown under it, only letting it have a degree of Heat equal to the common Heat of the Fire; and in that case the Bird seem'd no way affected with the Steam of the Brass. The reason of this Difference I take to be, that there is a great Degree of Heat requir'd to cause a Separation of the arsenical Parts of the *Lapis Calaminaris*, which enters into the Composition of the Brass.

From the Consideration of those Experiments, it appears adviseable not to make the Back-Plate, or line the Cavities of the Chimney that are most heated, with Plate-Brass; tho' we may safely use Iron or Copper. If we would use Brass, we may line the Jams or Sides with it, or such Places as are not very much heated.

Secondly, When the Author gives Directions about the curing of the Smoaking Chimnies, he mentions the *North Wind* as blowing down Chimnies; but what he says is only for *Paris*, and such Places that have the Sea on the North side. Such Eddy-Winds (as they are call'd) blow from the *South* when we have them here at *London*; and generally speaking, in all Places we may expect that Wind to blow down

down the Chimnies, which comes from the Sea; I mean when Chimnies are not commanded; for in such a Case there may be Circumstances that will make the Wind blowing from any Point to go down a Chimney; but otherwise we must prepare against the Wind blowing from the nearest Sea.

The Construction of a Chimney in which Turf, or Peat, is burnt.

IN Chimnies where you burn Wood, the Cavities behind the Back and Sides, after the manner that the *French* Author directs, are very useful; but where you have your Heat very strong, but less diffus'd, it will be proper to make the Cavities as near the Fire as possible; and tho' the Way of the Air wou'd be shorter, yet the greater Heat given to the Air in that Case, will make amends for the Swift-ness of its Passage. This is what we have endeavour'd to do in this Construction of a Chimney to burn Turf; and in the next Construction for a Chimney to burn Coal.

[*Plate 9. Fig. 1, 2, 3.*] The Shape of the Chimney and Model of it *K A Y e f k* are as in our Author; but here we have no Cavity under the Hearth, only we have a sort of divided Box of Plate Iron upon which the Fire lies, and an horizontal Cavity behind the Back, fac'd with Plate Iron, so low that the Fire lies against

gainst it; and from thence the Air is carried up a Passage in the Brick-Work in one of the Corners as high as the Mantle-Tree: From the Corner it is brought forward in the Side quite to the Canal of Tin under the Mantle-Tree, from which it is convey'd into the Room. The whole Mechanism of it will be easily understood by a sight of the Figures.

[*Fig. 1.*] Represents the horizontal Section of the Box or Cavities upon which the Fire lies.

D Y is the Entrance for the External Air in the 3 Figures.

a Y E *e* B is the first Cavity, whose Height E A *Fig. 2.* is equal to the Breadth *a* B of six Inches, and Depth E *a*, 18 Inches; which is the common Depth of all the Cavities, five Inches of them going into the Wall as far as E F G *b* beyond the Back.

B C is the Breadth of the second Cavity, *viz.* seven Inches, its Height C F (*Fig. 2.*) being only 5 Inches.

C *c* is the third Cavity 4 Inches high, and 9 broad. *c* *b* is the fourth like the second, and *b* *a* the fifth like the first: The Partition-Plates B *e*, F, *f* *c*, and G leave a Space of 6 Inches from the Wall, or from the Fore-part of the Box as it appears in the Figure. You see then that the Cavities are nearly equal every where to 36 square Inches. B

B *b*, is a Fender which is to be put on upon A *b*, in such manner, that the Pins under the Knobs may fall into the Rings B *b*.

The double Lines represent the Way of the Air under the Cavities as far as H, where it goes up towards *b*, as you may see in,

[Fig. 2.] Which represents a fore-right View of the Cavities and Back.

E *g* b I D, is the horizontal Cavity in the Back, the Bottom of which being of Plate Iron, rests upon E *e* and G *g* the first and last Cavity under the Fire, and the Fore-part is also a Plate of Iron at F I *b* g.

This Canal is 7 Inches high, and 5 deep into the Back.

D E I K L, is the Canal in the Brick-Work that goes up from the last over D I E Y of Fig. 1.

L *k* M R, is the Section of the Passage brought forward in the Side from the top of the last Canal, into the Canal under the Mantle-Tree, here represented by M K N O, and in no wise differing from that mention'd by the *French* Author. If you have not a Canal, the Air may go out at R.

[Fig 3.] represents the Section of this Chimney, by a Plane perpendicular to the Hearth and Back, where D Y represents the
the

the Entrance for the External Air, as it does in all the other Figures.

E A Y, the first Cavity under the Fire.

D H I, the Section of the horizontal Canal in the Back.

H I K L, the Passage in the Brick-Work in the Corner or Angle, whose Section must be 36 Inches, whether it be square or oblong.

L K M N, the Passage in the Side from the Back to the Canal under the Mantle-Tree, whose Section here represented is N O M.

N R the Way of the Air into the Room.

The double Line represents the Way of the Air where the Figure allows us directly to see it; and the single Lines winding, shew where Cavities face us endwise.

Tho' I have not represented the Bellows here, because some Peat don't need it; yet where a great deal of Air is requir'd to make Turf burn, as some sort of Turf won't burn without; then not only the Bellows is to be us'd, but the Cavity F f C (Fig. 2.) is to be sunk into the Hearth, its Top F f being carried down to C c, and an Iron Grate fix'd in the Line F f, thro' which the Ashes will fall upon the said Cavity and warm it. After the Fire is lighted and blown up, the Fender (whose Height is 3 Inches) may be put in, and its upper part will be in the prick'd Line E c G g.

Con

Construction of Chimnies for Coal-Fires.

AS Coal is the common Fuel of *England*, I reckon this Construction will be best lik'd, and most us'd, especially since the Charge of it will scarce be double the Price of a Stove-Grate. The whole Matter is a Grate of a particular Make, with a Box of Plate Iron behind the Back, that has only three Cavities, from which a Passage goes obliquely to the Corner in the Brick-Work, from whence it is brought forward in the upper Part of the Side, quite into the Canal under the Mantle-Tree, as in the last Construction.

[*Fig. 4.*] Represents a Section of this Chimney, by a Plane perpendicular to the Back and Hearth.

D Y, The Entrance of the External Air to go to the Bellows Z, by a Passage under the Hearth, and also for the Air to go up behind the Grate into the three Cavities, one of which is represented by Q D H I.

H I L, Is the oblique Way to the Corner made in the Brick-Work, which is better represented by the same Letters in *Fig. 5.*

L K M N, The Way from the last into the Canal under the Mantle-Tree, whence the Air goes into the Room thro'

R s r S, the Grate made convex, that the Bellows Z may blow more fully upon it,

it, the Wind from the round Cavity under *Z* being directed full against it.

s T, r t, Are the two Bars which come from each side of the Grate quite behind, to hold the Box of Plate Iron together, by means of another Bar *T t*, which is fix'd to the two former by means of the Keys *T, t*.

The fifth *Fig.* represents the Grate seen from before the Chimney.

D Y, The Entrance for the External Air.

D d y c, A thin Plate of Iron 8 Inches broad and 9 high, fix'd to the Back of the Grate, and let down an Inch into the Hearth, as a Means to bring the External into the first Cavity *d E F*, which goes into *d D y c*. This Plate is also represented in *Fig. 10.* tho' here it is supposed cover'd with Plaister of the Thickness of the Back of the Grate.

H I i b, Is another thin Plate 8 Inches square, likewise fix'd to the backside of the Back of the Grate in order to begin the Cavities *H I L*, which may go deeper into the Back, than such Cavities as are cover'd with a Plate; Mortar being laid over the Plate *H I i b* to make all tight. The same Plate is represented by *Fig. 11.*

K N M L, The Section of the Passage along the upper part of the Side from the Back to the Canal under the Mantle-Tree.

N M O, The Passage under the Mantle-Tree.

Y Z, The Passage of Air to the Bellows.

Bb, The Fender, which is set upon the Trap-Door of the Bellows when you don't blow; but backward where the prick'd Line is, when you blow.

C f, c D, The two Feet of the Grate which come directly from the Back of the Grate, and touch the Back of the Chimney. P s, p S, The two other Feet which are forwarder, as standing under the bend-ed cross Bars R s, S r, which hold the main Bars together.

T c t, f s Q S D, the upper and lower main Bar, which as well as the others, are bent into an half Oval.

F d D S Q s, A small Bottom-Grate for the Ashes to fall thro'.

The winding double Line, shews the Way of the Air, and the single Line, which takes two or three Turns, shews the same in such Cavities as are seen end-wise in all the Figures, which compared together explain one another.

DIRECTIONS *for the* WORKMEN.

TAKE a Plate of Iron 2 Foot long, and 18 Inches broad, and $\frac{1}{4}$ Inch thick (*fig. 6.*) and cut off the upper Corners at F and I, so as to make it of the Shape represented

presented in the Figure. Then rivet to the Backside of this thick Plate, the two thin Plates $H I i b$, and $D d Y y$, before describ'd, and you will have the first Piece.

The Partition Plates must be as thin as may be, six Inches broad, and fix'd edge-wise to the great Plate against the Lines $e F G H D$, and $E d f I$; they are seen edge-wise in *fig. 7.* so that if you imagine the sixth Figure laid upon the seventh, you will have the second Piece.

$D F G H e$ (*fig. 7.*) Is the first of these Partition Plates, which may also be seen in *Fig. 8.* where the prick'd Lines represent the folding Places, where the Plates must be bent into Angles equal to F , G , and H in *Fig. 7.*

$E d f I$, (*Fig. 7.*) Is the same as the *Fig. 9.* where the Letters denote the Plate and its Folding-places, as before.

[*Fig. 12.*] Shew the Box seen from behind, closed up with a thin Back-Plate $F T D d t$, which Plate is held on by a Bar $T t$ key'd on to two little Bars on the Sides, such as $t T$.

The Plate $D d y Y$, behind which the Tube comes, to bring in the external Air, supports one End of the Box, while the Foot C supports the other.



APPENDIX

By Dr. DESAGULIERS.



AFTER having published this Book, above Twenty Years ago, in *May* 1715, I made a great many Experiments upon *Coal-Fires*, and found the following *Construction* the most advantageous.

Plate X, The Line *f* F and *y* G *g* (*Fig. 1.*) represents the Back of the Chimney, into which you must cut an Hollow about 7 Inches deep, as F A B G to receive the hind Part of an Iron Box M A B K *l* *y* and *n*, (such as is represented without its Back-Plate (*Fig. 2*) whose fore-part will stand out as far as M *n* and *l* K. The Cavity which receives this Box must be ten Inches above the Hearth, only the two Plates, which make the Returns on the fore-part at M *n* and *l* K must be continued below the Bottom of the Box down to the Hearth, that at M *n* to receive a Tube of 7 Inch Square abutting against it, and the other to be only as a Foot, and fill'd up behind with Brick-
L Work.

Work. The Tube made of Plate Iron, not represented here, serves to bring in the outward Air, and has a seven Inch Opening in the upper Part of its End to join to, and correspond with the same sort of Opening in the Bottom of the Box, into which the Air passing, (when the Box is heated by the Fire, made in the Grate before it) goes thro' all the Cavities, which are five in Number, and comes out of the Box thoroughly warm'd, at the upper Part over *I K*, and so is convey'd into any Part of the Room in any of the Ways which have been describ'd, provided its Issue be at least as high as the top of the Box. The manner of bringing the External Air into the Box is also easy, and need not be any more explain'd.

The Chimney on each side of the Box, or the Spaces *f F M m* and *G K k g* may be filled up with Brick-Work, and before it may be fix'd parabolical Jams or Cheeks of Brass, Copper, Marble or Fire-Stone, as *M p* and *K q*.

Such a Grate as is represented in *Fig. 3.* must be fix'd to the Front of the Box, by Screws, on the Wings of it, *W w* and *O o*, and its Sides *W X*, *O Y*. N. B. *If the Room be large, that you may have the more Fire, the Grate may come two or three Inches forwarder than the Front of the Box, and have one or two perpendicular Bars behind W X and O Y.* The

The Make of the Iron Box is best understood by a View of the second Figure, which is a Perspective Drawing of the said Box, seen from behind, when its Back is taken off, to shew the Cavities which are Square, and give a seven-Inch Passage every where for the Air; that is, the Section of this Square Tube is 49 Square Inches.

The white Space between the crooked Lines represents the Passage of the Air, except in such of the Cavities as are hidden in the present Situation of the Box; namely the Perpendicular one above *A*, where the Air goes in first, rising up to *m n*, and turning backwards horizontally towards *d*, where the Lines represent it; and also the last Cavity, which is likewise perpendicular, and receiving it behind *x*, discharging it at *B*.

o n m e d a b C i k l o is the Iron Box, whose Back-Plate is taken off at *a b c d*.

e m n o, and *l k i c* represent the upper Part of the Returns forward, the rest being out of Sight.

o and *y l*, which makes the fore-part of the Box, or hind-part of the Grate, is of one Piece with the two Front Returns, whose upper Parts are marked *o n m* and *l k i*, and must be a pretty thick Plate (near a quarter of an Inch) to bear the Fire the better; but all the other Plates may be thin.

Under $e o$ there is a perpendicular Partition-Plate parallel to the Plate $m n$, reaching only from q^* to the Bottom at l , and that there may be an Opening from the first Cavity to go horizontally backwards, which is $e o q^*$, whose lowest Part is seen in this Figure.

$p q r s$ is the first horizontal Partition-Plate behind the top of the Fire, seven Inches deficient from the End at $r s$.

$x t u w$ is the Second, or lowest inward horizontal Partition-Plate, deficient at $u w$, to let the Air which came over it, come under, and go in at the Hole $y g t z$, Part of which is seen at $y x$, up the last Cavity.

$l b t z$ is a perpendicular Partition-Plate deficient at Bottom, to make the last Cavity $y g b l k i$, which is open at $i k l b$.

A and D are two Pieces of Plate like Feet fasten'd to the Bottoms of $m n$ and $k i$ the Returns of the Front Plate.

Tho' we have made the Cavities here of seven Inches Square, and the Distance $O l$ of the Cheeks 17 Inches, those Proportions may be alter'd, according as the Room is bigger or less.

There is no need of the Bellows in this Construction, the Draught being very strong without.

N. B.

N. B. *This will cure most smoking Chimnies; and this Method is very useful for Green-Houses, in which Exotic Plants are preserved.*

There is another way of warming Rooms, which is very simple and easy, serving as well for *Wood-Fires* as for *Coal-Fires*; and of small Expence. It consists in contracting the Passage up the Chimney just above the Fire, when the Fire burns clear, and giving more Room when fresh Fuel is put on, or the Fire is first kindled. By this Means, when the Fire burns well, very little Air will pass up the Chimney with the Smoke; but what passes, will move with great Swiftnes, whilst the rest of the Air (which comes crouding from all Parts towards the Fire) will only be warm'd and beaten back into the Room which it will very much warm. When fresh Fuel is put on, this contracted Passage being too small will not let all the Smoke go up, which is then increas'd; but it may be open'd wider and kept open till the Fire burns clear, when you must again contract it. By this Method I made the House-of-Lords warm some Years ago. The Complaint was, that a great Fire always made the House colder instead of warming it; by Reason of the great Draught of Air towards the Fire which cool'd Behind all those who

stood near enough to the Fire to warm themselves Before; while those who were farther off, only saw the Fire without receiving any Benefit from it, and a great Wind was made by opening any one of the Doors, when the Fire burn'd briskly. The Manner in which I cur'd it, was this: The Passage up the Chimney is represent'd by A B C D (Plate X. Fig. 4.) I caus'd it to be chang'd into the Figure A E G I L M K H F B, by setting up the parabolick Jams A E G I and B F H K, and filling up the Space A B L I. A little above the Mantle, within the Chimney, I fix'd an horizontal Plate A E F B, which has two other Plates F E H F and G I K H joyn'd to it by Hinges at 1 2 3 4 5, and so moveable as to turn up and lie over one another as there is occasion to open or contract the Passage up the Chimney; which is done by means of a Chain fasten'd to N, and coming quite into the Room, to a Ring above the Mantle-Tree. At first kindling the Fire, which is of Wood, the Chain must be pull'd, as much as can be, and fix'd, whereby the Plates G H I K and E G H F will be lodg'd above the fix'd one A E F D, leaving the Passage F G I L M K H F quite open, so that the Smoke will freely go up. As the Fire comes to burn briskly, and the Smoke diminish, by means of the Ring and Chain,

the

the Plate F G must be let down into its horizontal Situation; then the Passage left will be G I L M K H. Lastly, when the Fire burns quite clear, let down the last Plate G I K H, and there will be only left the Passage I L M K, in which Case the Room is very warm. Every time that fresh Wood is put on, draw up the first Plate G I K H, for a little while, to let the new Smoke pass, then let it down again. When the Fire is in good Order, if the Plates be all drawn up, by way of Experiment, one may feel the Air go up the Chimney very cold, and blowing very strong, by holding ones Hand at E or F. But if the Plates be let down, so as to leave only the Passage I L M K, the Hand will feel no Wind, even tho' all the Doors be set open.

Mr. Robert Phillips (living in *Great Queen-street*, near *Lincoln's-Inn Fields*) having well consider'd these two last Constructions, has, upon those Principles, invented a New Grate, which he calls his *MACHINE Fire-Grate*, so very effectual for warming a Room, and preventing the Inconveniencies of Smoke, that I have pull'd down mine, with which I have warm'd my *Experimental Room* these 20 Years, to set up his, which I find to be better, as well as cheaper, than what I had.

Here follows the Description of it. See
Plate X. L 4 The

The Grate of *Fig. 3.* stands in the Box of *Fig. 5.* whose fore-part is *A B C D*, and hind-part *a b c d*, which has an Hole *E F* in the upper Part of its Back, thro' which the Flame and Smoke is to pass.

There must be an Hollow in the Back of the Chimney, such as is represented by *a b c d e f g h* *Fig. 6.* This Hollow is cover'd with an Iron Plate *e f g h*, with an Hole *H G* in its upper-part, which Hole exactly answers to the Hole of the Grate-Box, when set against it, quite close, as it must be in the Use of the Machine.

There is a bent Plate *i k F G A i*, fix'd edge-wise to the abovemention'd Plate behind it, reaching from it to the Back of the Chimney. Observe, that the Space behind the great Plate and Machine is always open'd upwards into the Chimney at *a b f e*, and is by the Plate *i k A* divided into two unequal Parts. There is behind the great Plate a prismatic Frame *E H F G D*, with a flat Shutter, (whose Axis is horizontal at *E D*) which is mov'd by the Handle *H*, so as to shut the upper Side of the Frame *E H F D*, or the lower Part of it *B*, at Pleasure; the Shutter reaching from the Wall to the Plate *e f g h*. In the Figure one may see the Shutter ready to shut the upper Passage *H E D F*, leaving open the under Passage *B*; and in that Case all the Flame and Smoke going

ing thro' B must turn outwards, and move according to the Direction shewn by the doubled-prick'd Lines 1 2 3 4 5 6 7 going under the bent Plate, and turning up again thro' an Hole of four Inches at 6, which is open'd by Means of the Handle *b*, which removes the Plate C, to open a Passage of four Inches square that way.

It is plain, that in this Case so little Air passes up the Chimney with the Smoke, that the greatest part of the Air, which is warmed near the Fire, is reflected back into the Room; because the Passage before the Grate, under and behind the Mantle-Tree, is quite shut up by the Frame of *Fig. 8*, which is always kept shut at H, except when its Shutter *a b* is open'd for a Boy to go thro', in order to sweep the Chimney, or when you find the Room too warm, and would cool it.

At the first kindling the Fire, the Passage B of *Fig. 6*. must be shut, as is represented in *Fig. 7*, that the Smoke which, will then be in great Quantity, may go directly up the Chimney, and out of the Machine at *a e k i*.

N. B. Should the Chimney at any time be on Fire, it would immediately be extinguished by shutting B and C.

The Plate fronting the Title-Page, represents Mr. *Phillips's* Machine when quite finished and fix'd up. N. B. Several
Workmen

Workmen, or rather Undertakers of Work, are endeavouring to imitate this new Contrivance, making some Changes merely to evade the Force of his Patent; but if they make any Alterations, I dare say it will be for the worse; therefore I wou'd advise such as want to have their Rooms warmed, and Chimnies cured of Smoking, to apply directly to Mr. Phillips.

Channel-Row, *Westm.*

Nov. 1, 1735

J. T. D.



*A DESCRIPTION of a Fire-Place,
and Chimney without Smoke, the
Smoke being burnt, as described
by Dr. Boerhaave in his Chemical
Lectures.*

THE Inventor of this Instrument was that ingenious Artist *Dalesmus*, who contrived it at *Paris*, in the Year 1686, * The famous *Justeleus* afterwards first published a Cut of it in the *Philos. Trans.* almost at the same Time, which is as follows. Plate 9. Fig. 13. A B C D is a hollow Cylinder made of Plates of Iron, open at both Ends, within whose inferiour Base B D there is fitted the Grate B D. This Cylinder, which is the Fire-place of the Instrument, is joined to the Cylic-Tube E F G, in such a manner, that there is a Communication between their Cavities. And this Tube E F G, which is of the same Capacity with A B C D, made of the same Metal, and in the same Manner, is open at G, and close at E. If then the Tube E F G, is made very hot, and some live Coals are laid on the Grate B D, and over them some combustible Matter, then the Flame that is produced will descend into

* See *Journal des Sçavans*. 1686. pag. 116.

to the Tube E F, and pass through F G, and all the Heat will go out at G, and the Smoke likewise that is generated, following the same Course through the Tube E F G, will be forced to pass through the Flame that fills the whole Tube; and hence being acted upon by the Fire in all this Passage, it will lose the Thickness and Disposition of Smoke; will be converted into Flame, and in this form passing out of the Aperture G, will disappear, without any visible Smoke, or Soot. The famous *De la Hire* has added some Notes upon this Machine in the Journal above cited.

In order now says *Dr. Boerhaave*, speaking to his Auditors, to give you an Ocular Demonstration of the same Thing, I have provided this Instrument which is made of Plates of malleable Iron. Plate 9. Fig. 14. A B C D E F, is a hollow Vessel consisting of five equal Iron Plates well soldered together, and open only at the Top A B C D. At the Height E I within the Vessel there is a Grate I K L M. In the side D F, there is an elliptic Hole N O, of the Breadth M K, and Height E I, to which is joined the Tube O G H, open at O N and H, and every where of the same Capacity. Please now to observe the Effects of this Machine. On the Grate I K, I lay some live Coals, that the Vessel may grow hot, and that the Air in
the

the Cavity of the Tube N O G P, may at the same time be heated likewise, I put some more on the part of the Tube N P. As soon as ever now the Air below the Grate, and in the Tube N O G P, grows hot, the Heat that was produced by the Coals above the Grate in the Vessel C K is diminished; and the Heat in L F below the Grate, and in the Tube N O G P, is in proportion increas'd; so that now you observe the force of the Fire, with its little Flames, tend downwards, by which a new Degree of Cold is generated above the Coals that are laid on the Grate. The Machine being thus prepared, when I lay this Straw upon the Coals, you see with what rapidity the Flame drives downwards through the Grate, and through all the Tube O G H, so that it breaks out at the top, H, without Smoke, and there produces a very great degree of Heat; whilst at the same time the space C K continues cold. But farther, whilst I add *Wood, Turf, Sulphur, and Oils*, it proceeds exactly in the same Manner, and the Force of the Fire is so great within the Tube, that the Tube you see is now red hot, and the Fire burns with so much Fury and Rapidity, that one may hear the Noise that is produced by the Agitation of the Flame. You take notice too, at the same time, that these Bodies, which commonly, when they

they are burnt, diffuse an intolerable Fetid, or a very agreeable Scent, now they are laid on this Fire, don't discover any smell at all, but perfectly consume without the least sign of it, leaving nothing behind them but pure Ashes at the bottom of the Vessel under the Grate. All the other Parts are driven by the Force of the Air pressing upon the Aperture of the Fire-place, into the Tube which is higher, and narrower than the Vessel that contains the Fire; so that all the Flame, and the power of the Fire, exerts itself within the Space L F O G H; and hence, the combustible Parts that are reduced into a very dense Smoke by the Action of Fire, are now carried through this pure Flame, and not into the open Air; by which means, being thus strongly agitated by the violence of the Fire, even within the Fire itself, they are so attenuated in their Passage, that every part of them that was Combustible, or could be so divided by the Motion of the Fire, as to become perfectly imperceptible, is dissipated into the Air, without discovering the least Sign of any particular Quality. Smoke therefore is combustible Matter, exceedingly agitated, but not yet shining, or red hot; Flame is the very same Matter, only thoroughly red with Heat, and divided into very minute Particles.

F I N I S.

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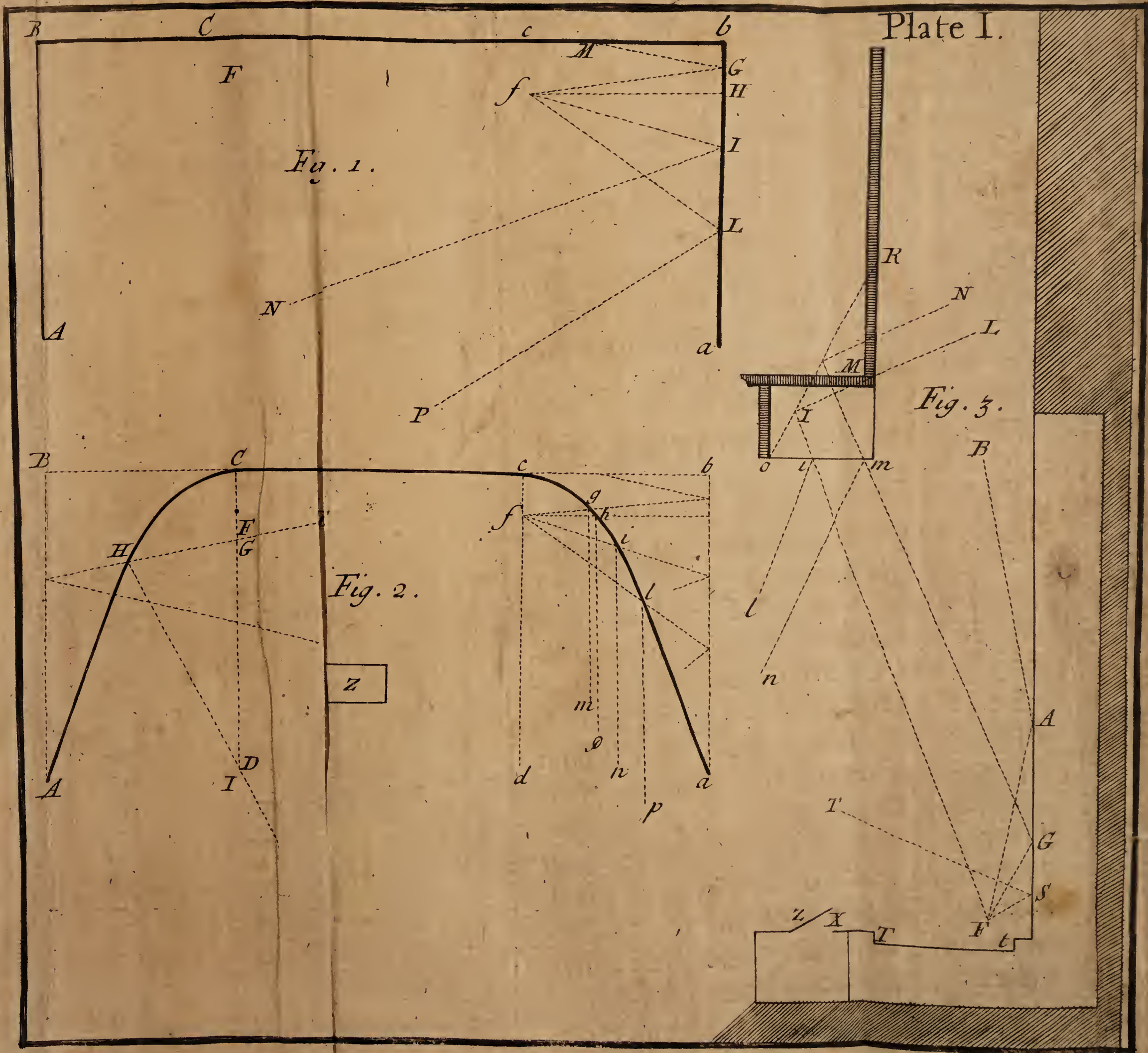
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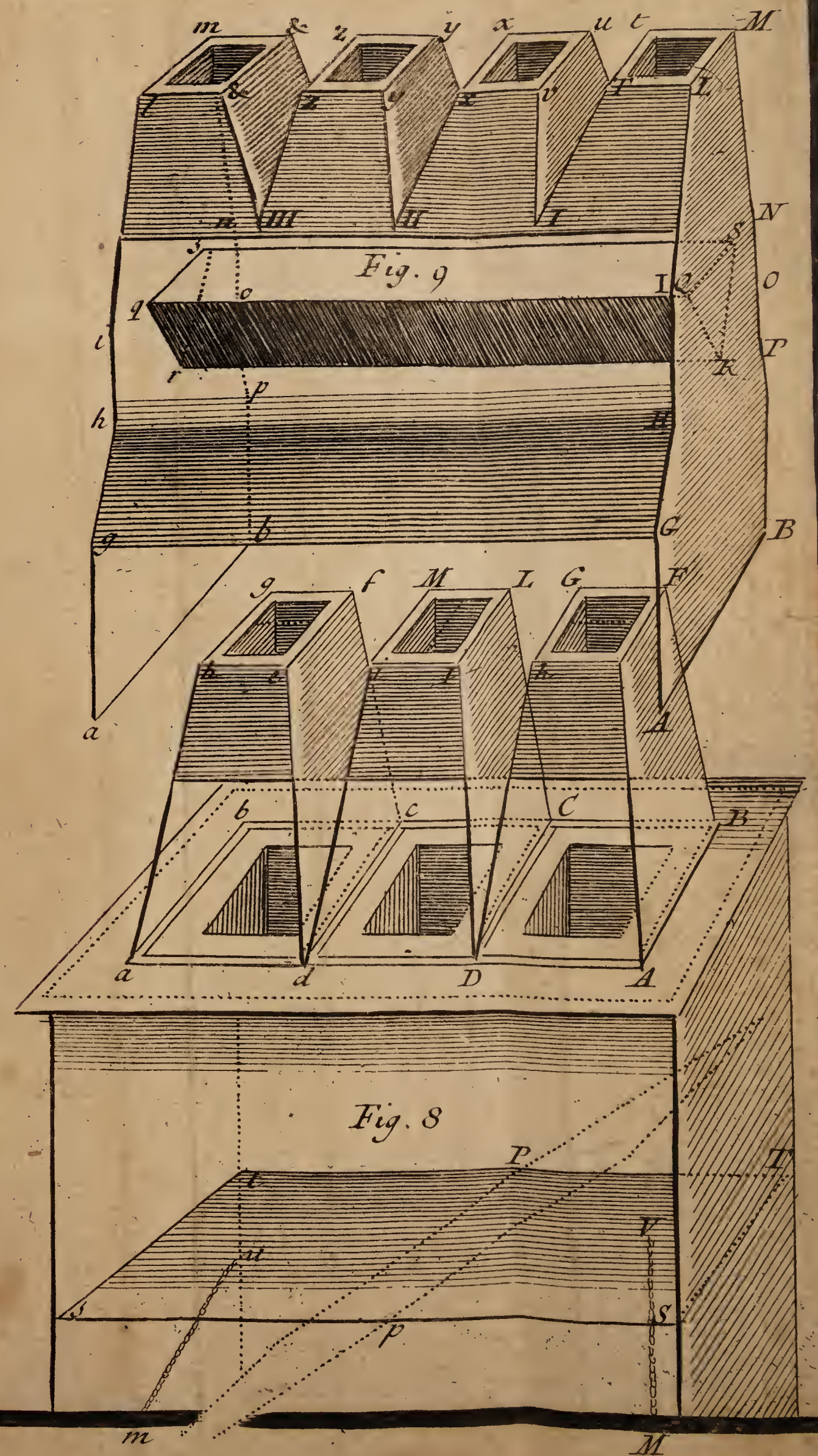
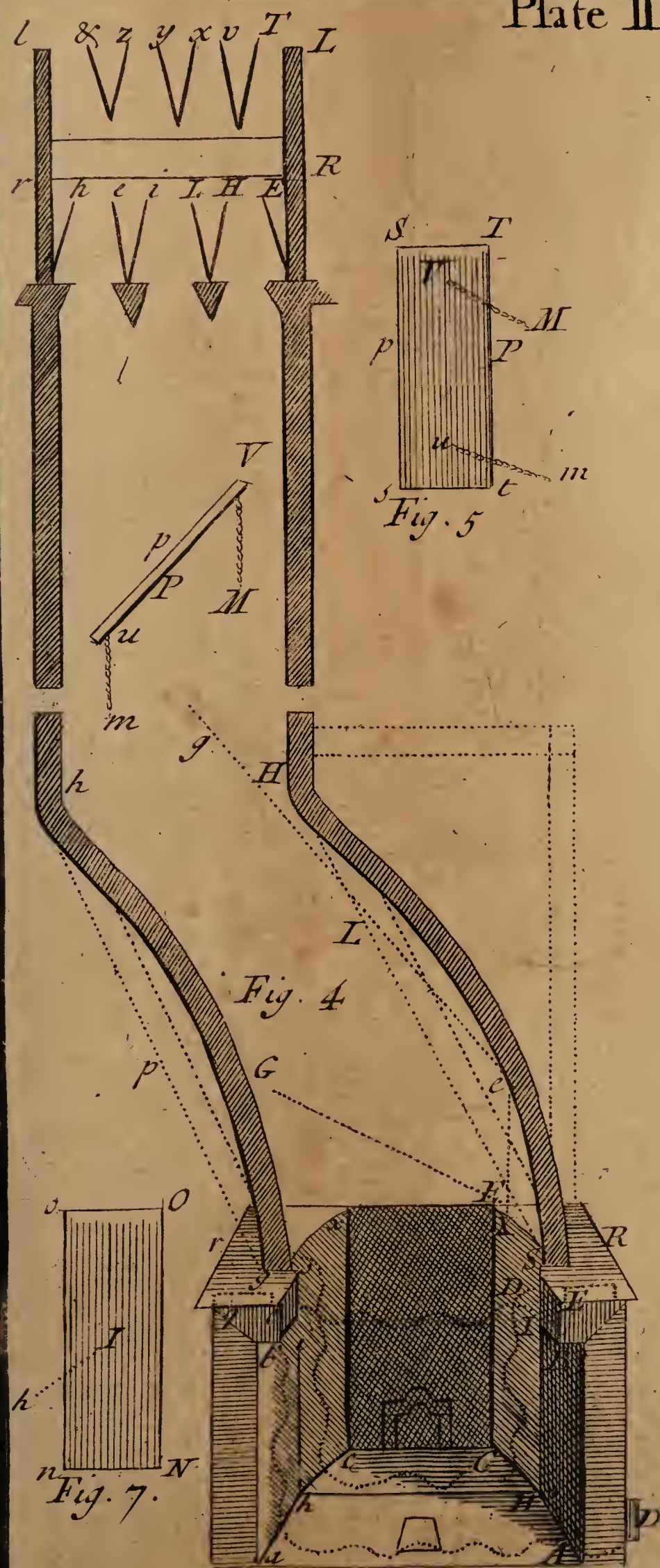
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No. 1



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Plate II.



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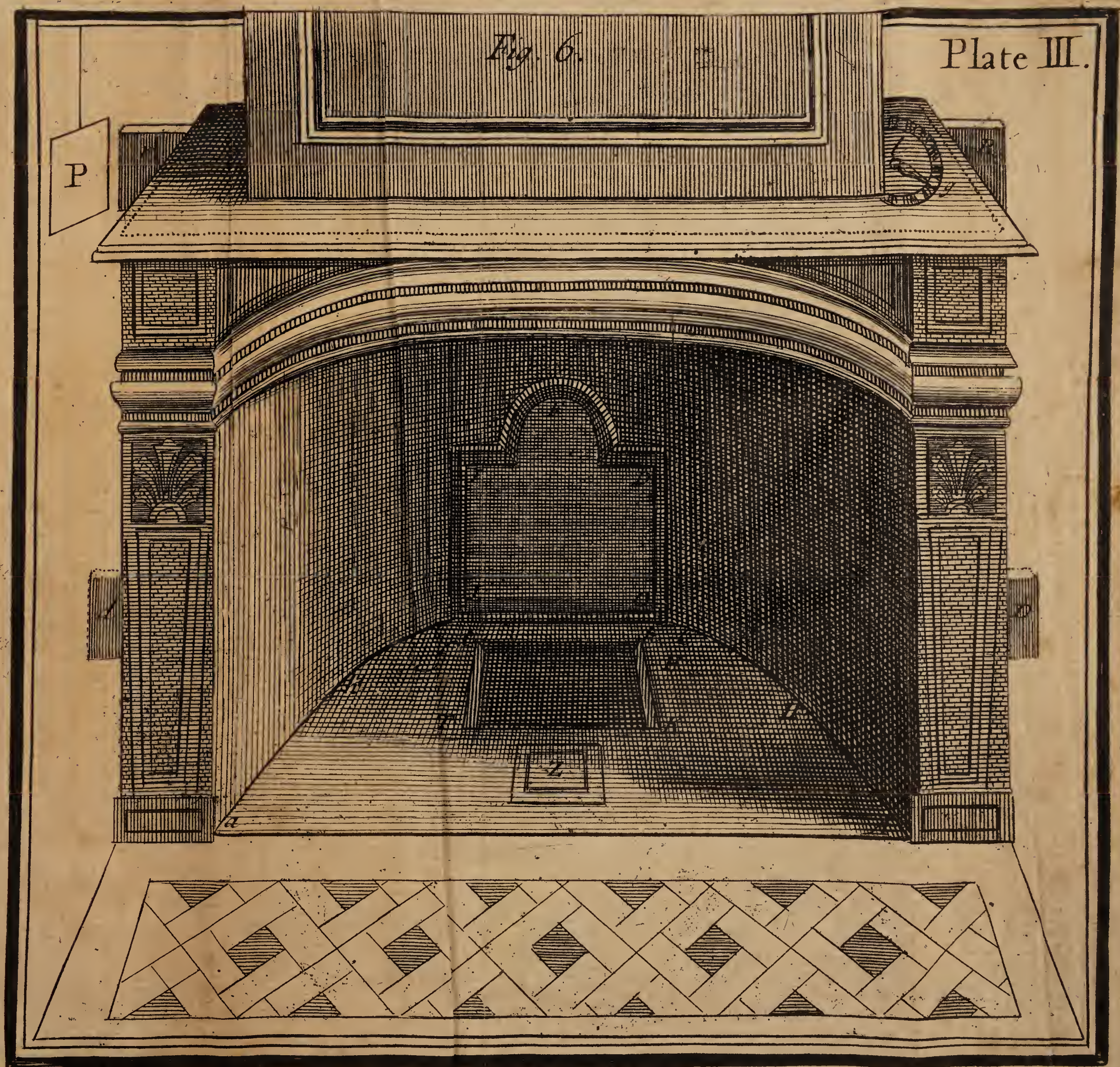


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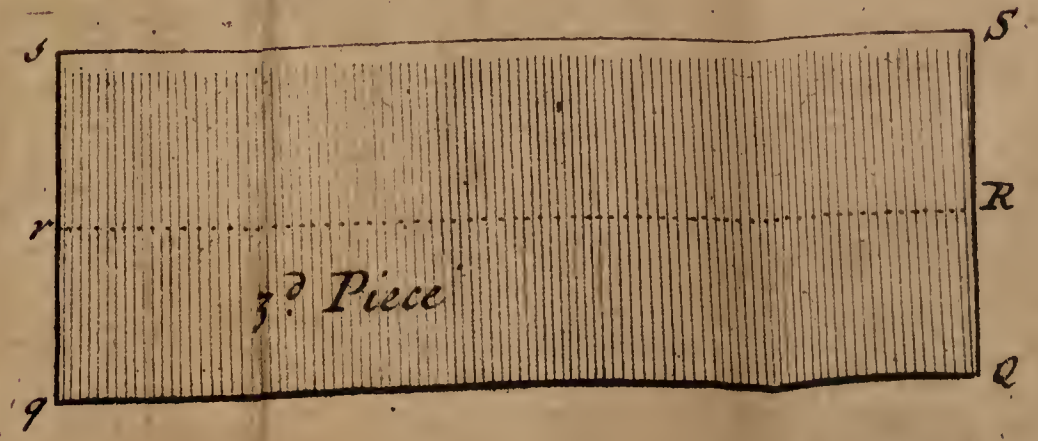
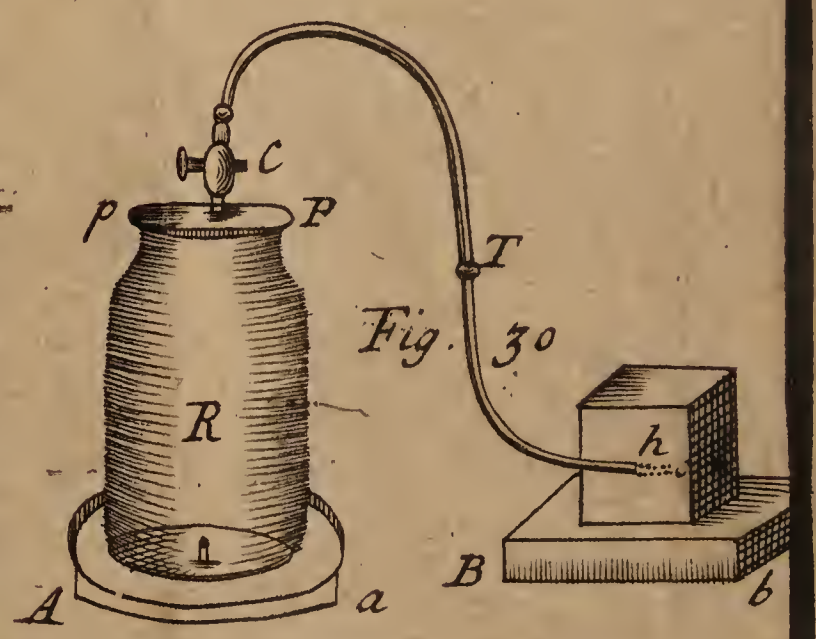
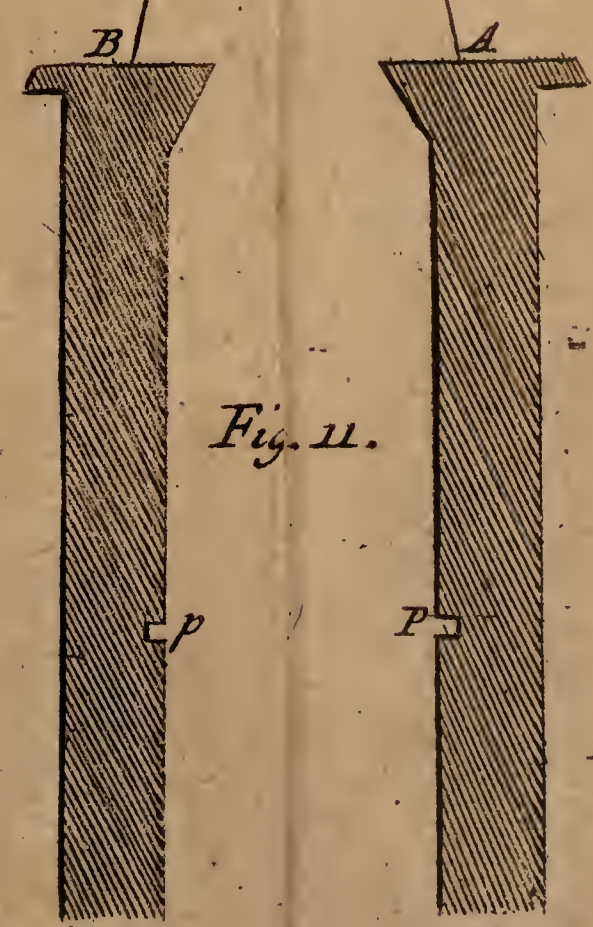
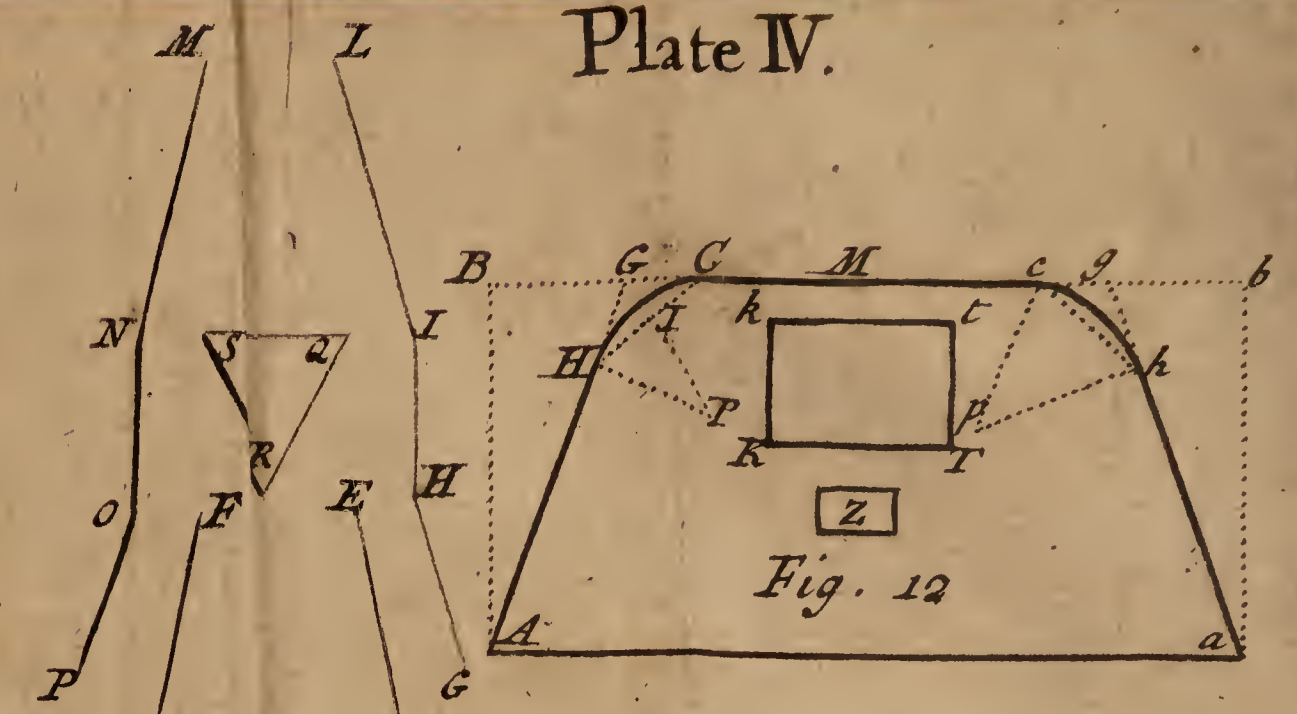
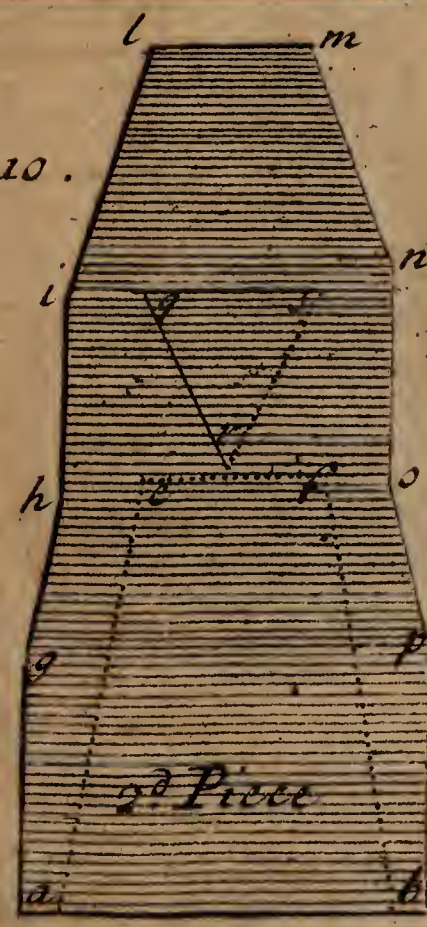
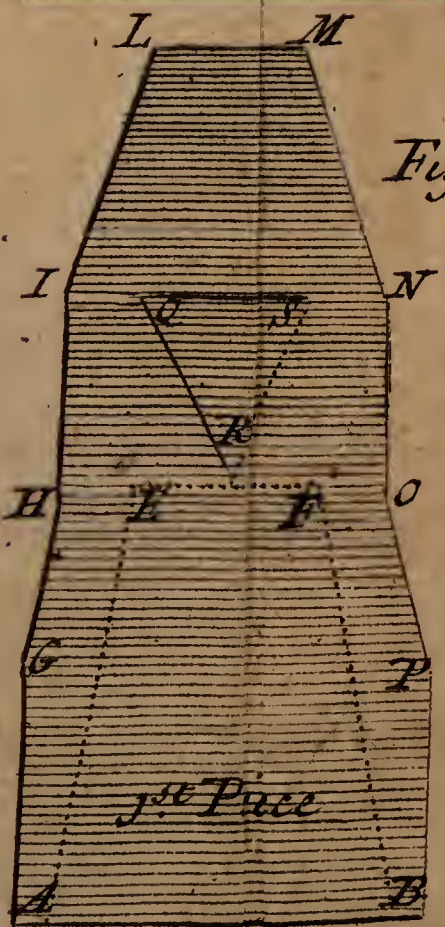




Plate V

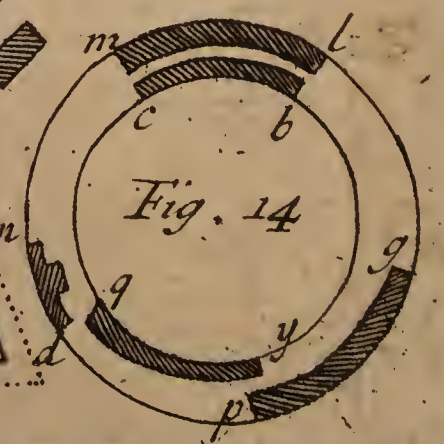
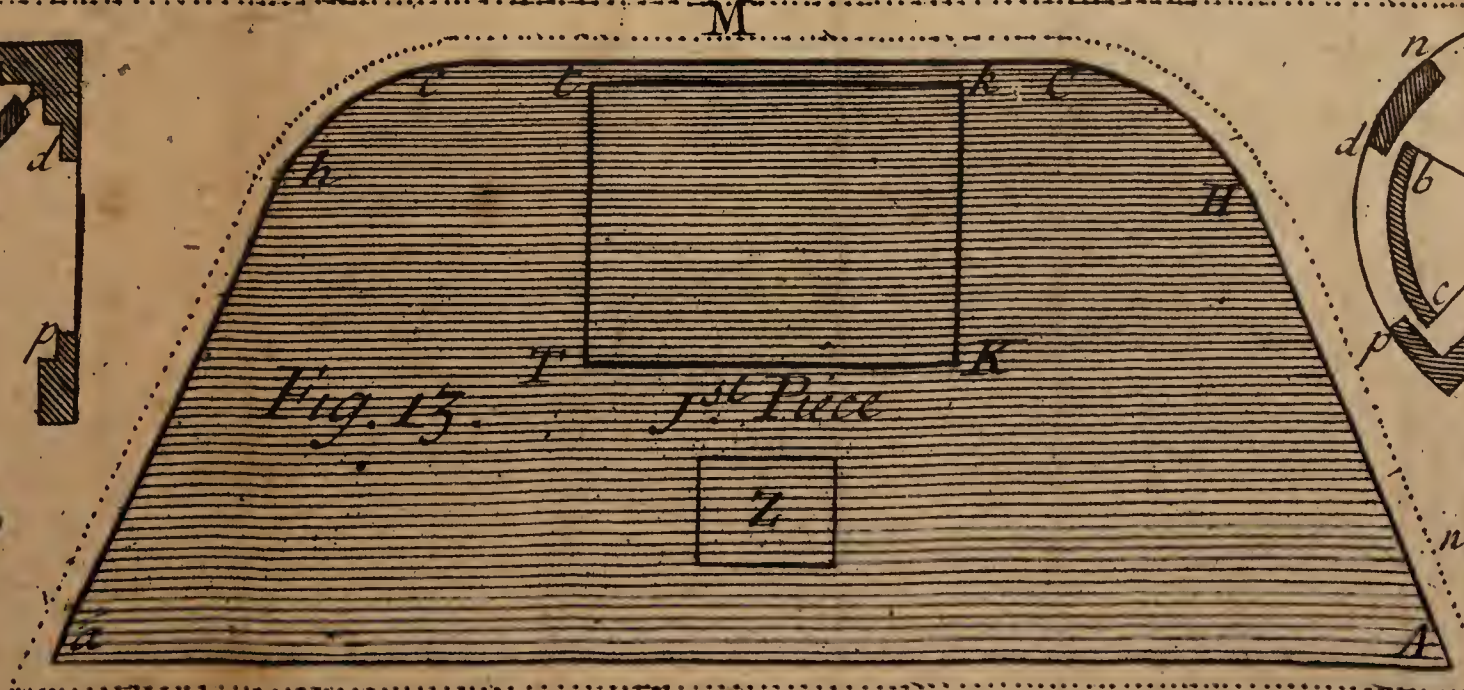
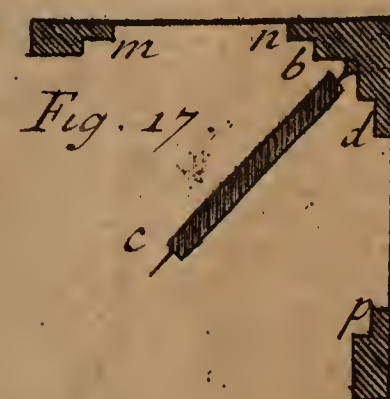
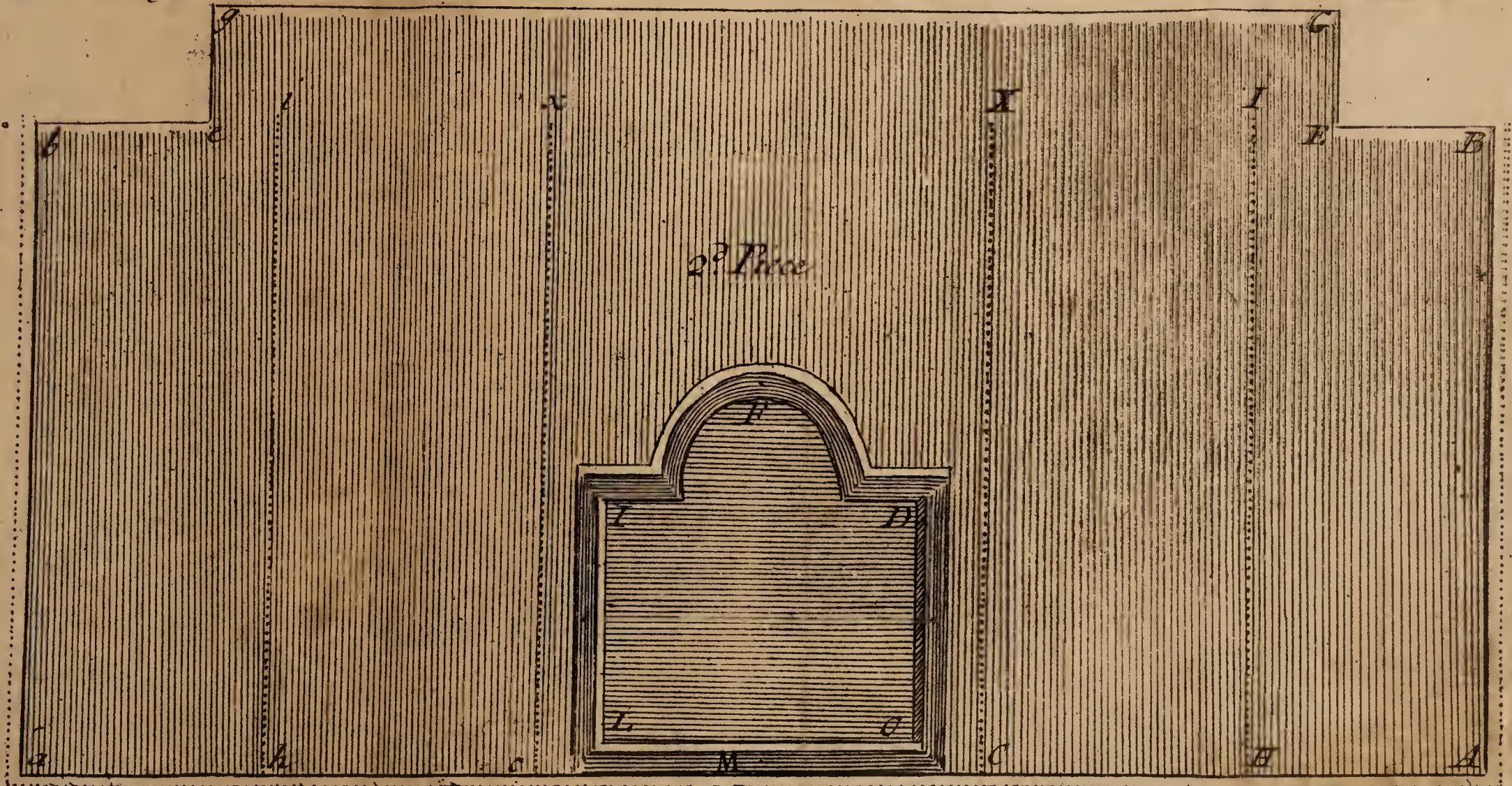
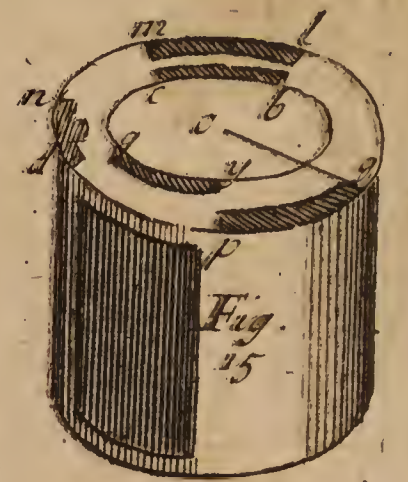
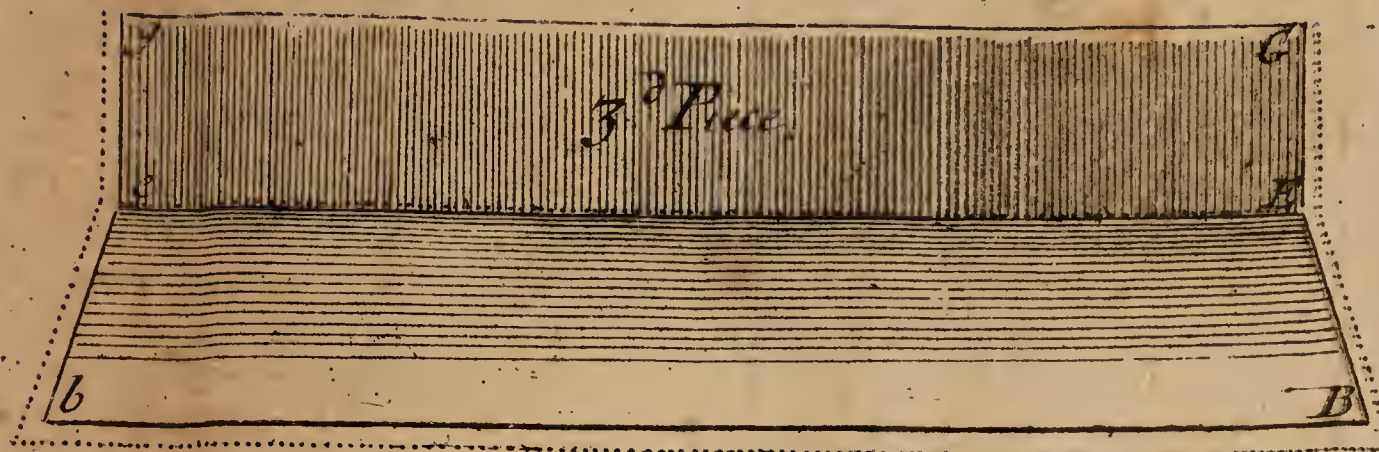
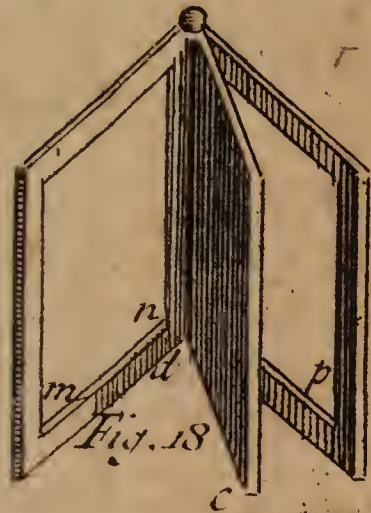


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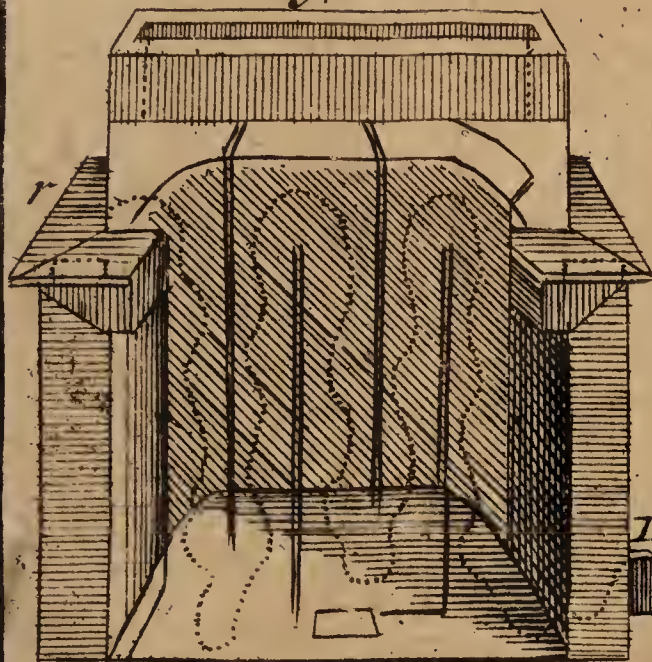


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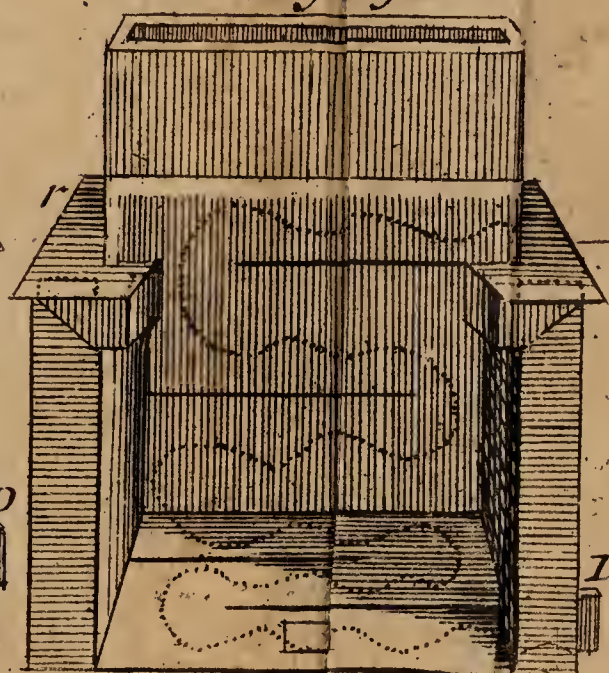


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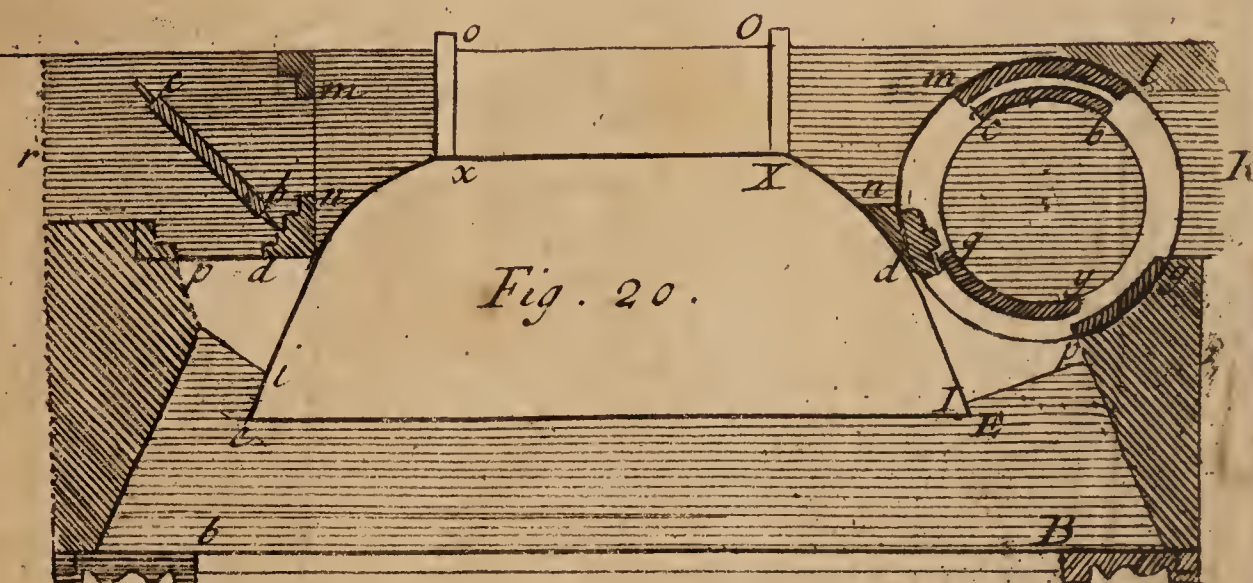


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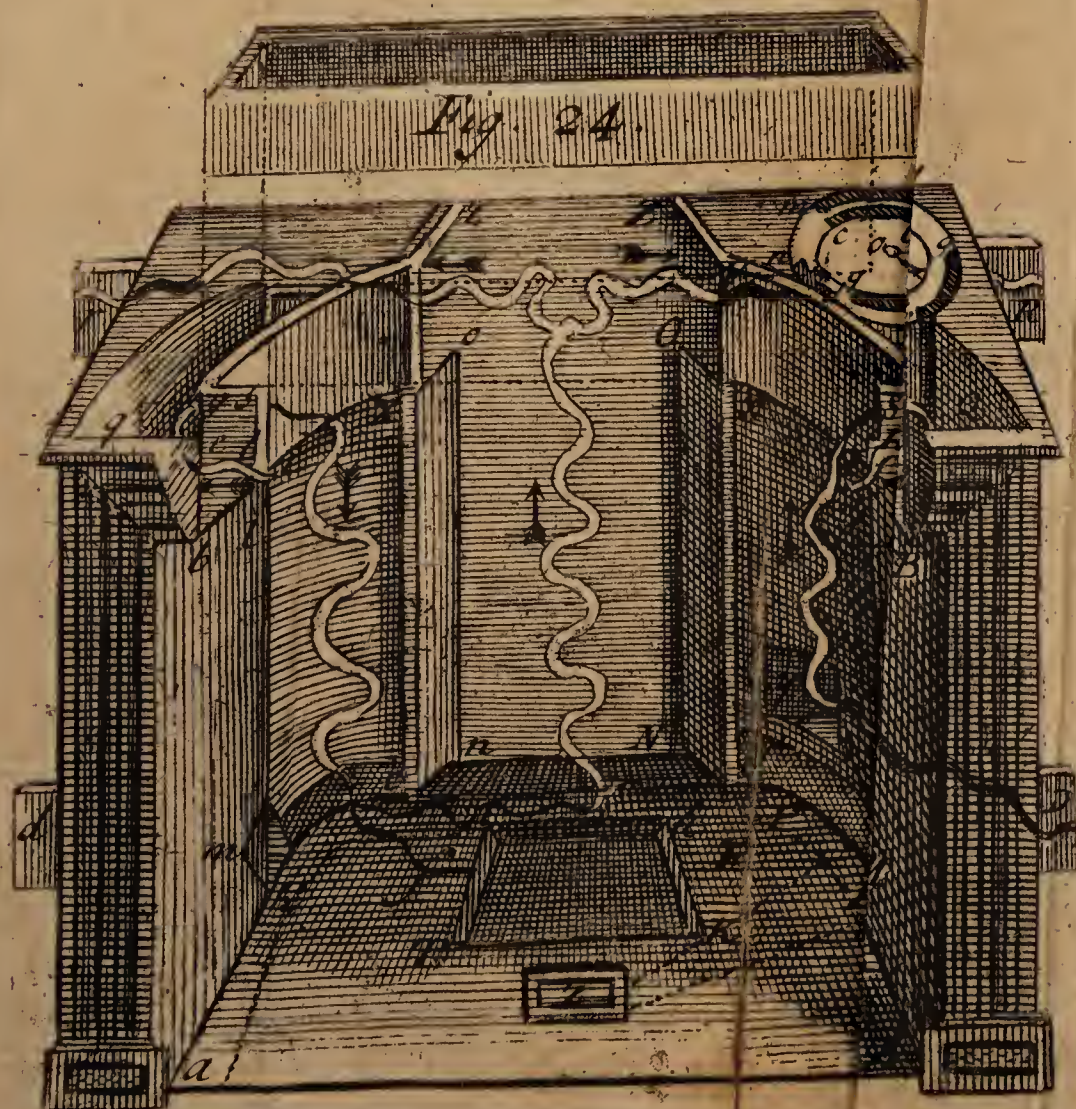
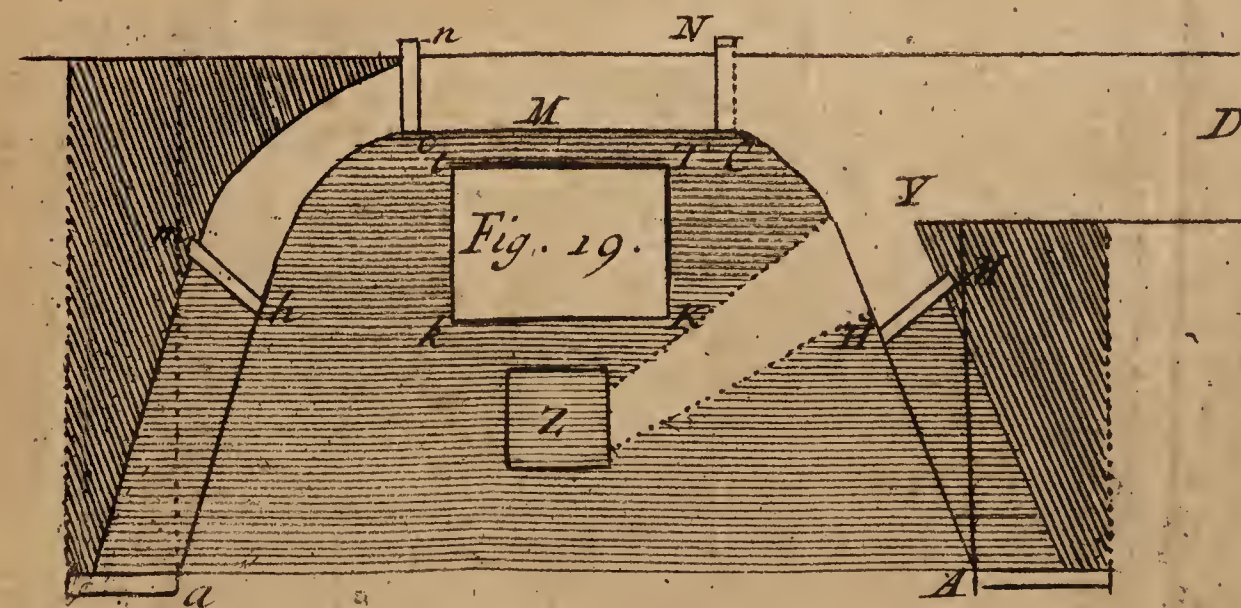


Fig. 19.



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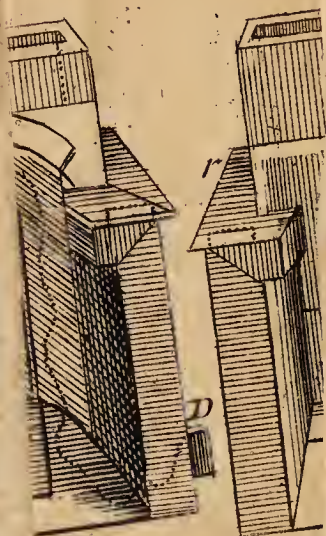
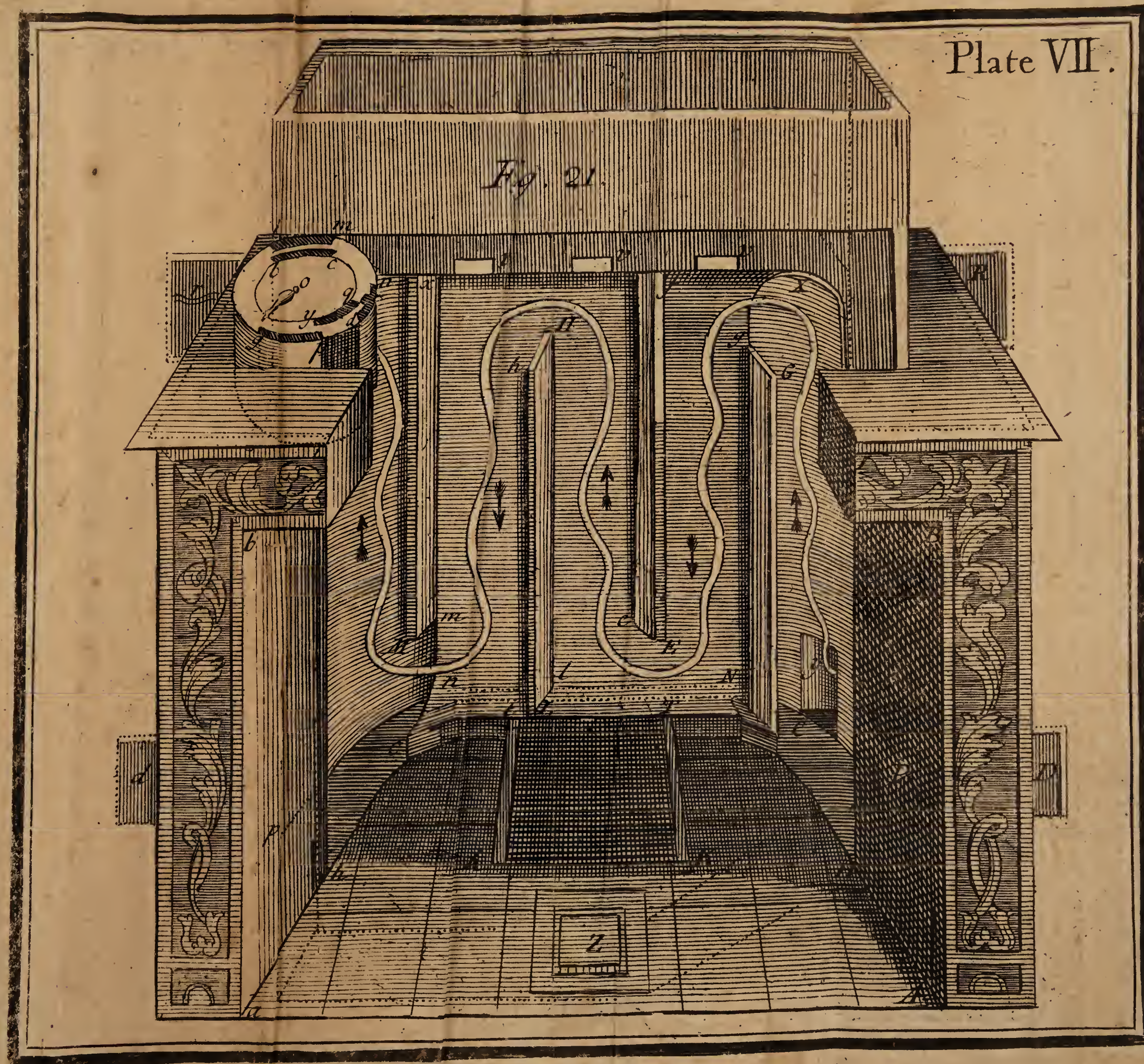
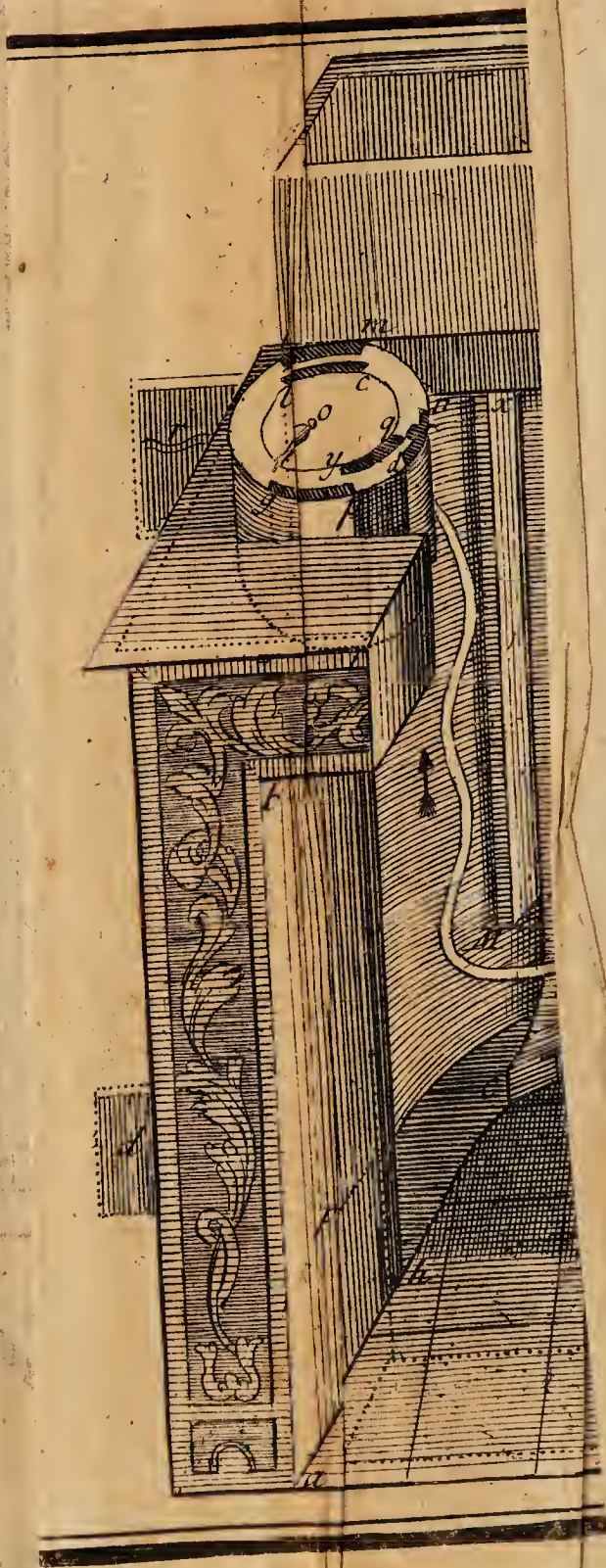


Fig. 24.







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Plate VIII

Fig. 28



Fig. 26

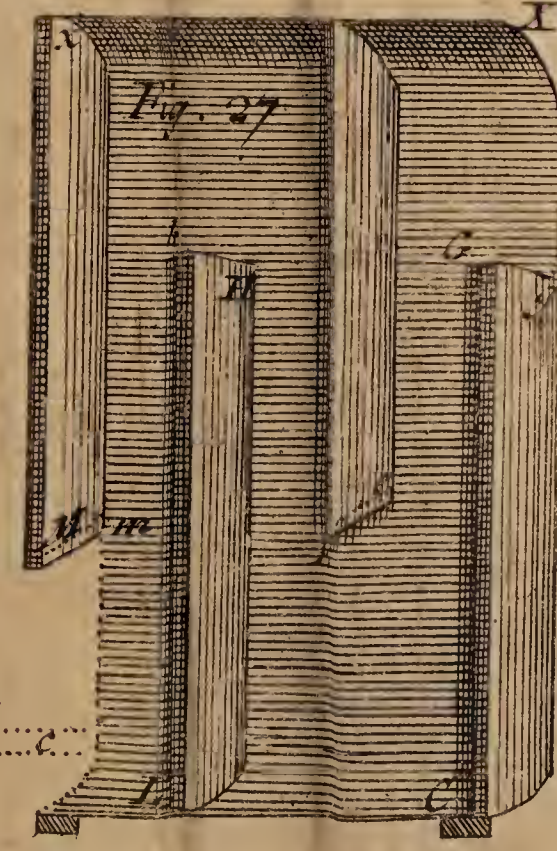
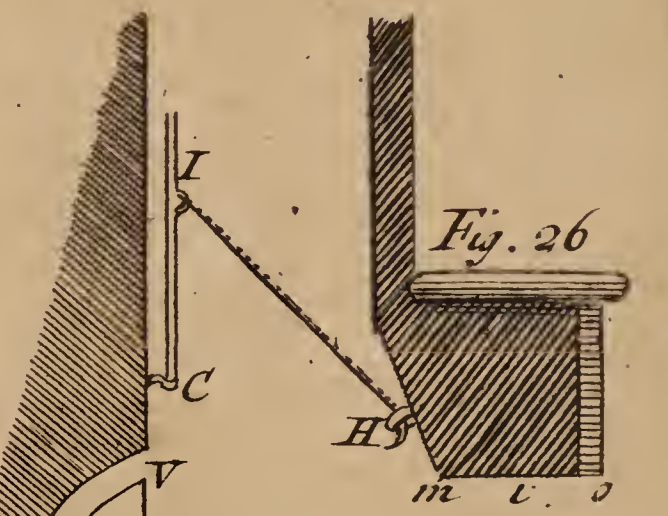


Fig. 29



Fig. 25

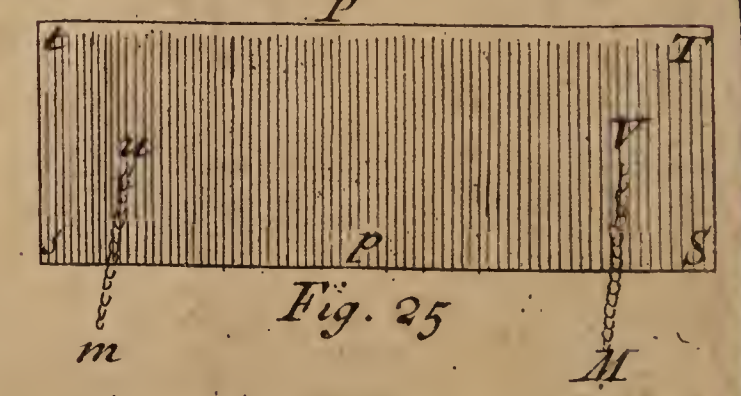


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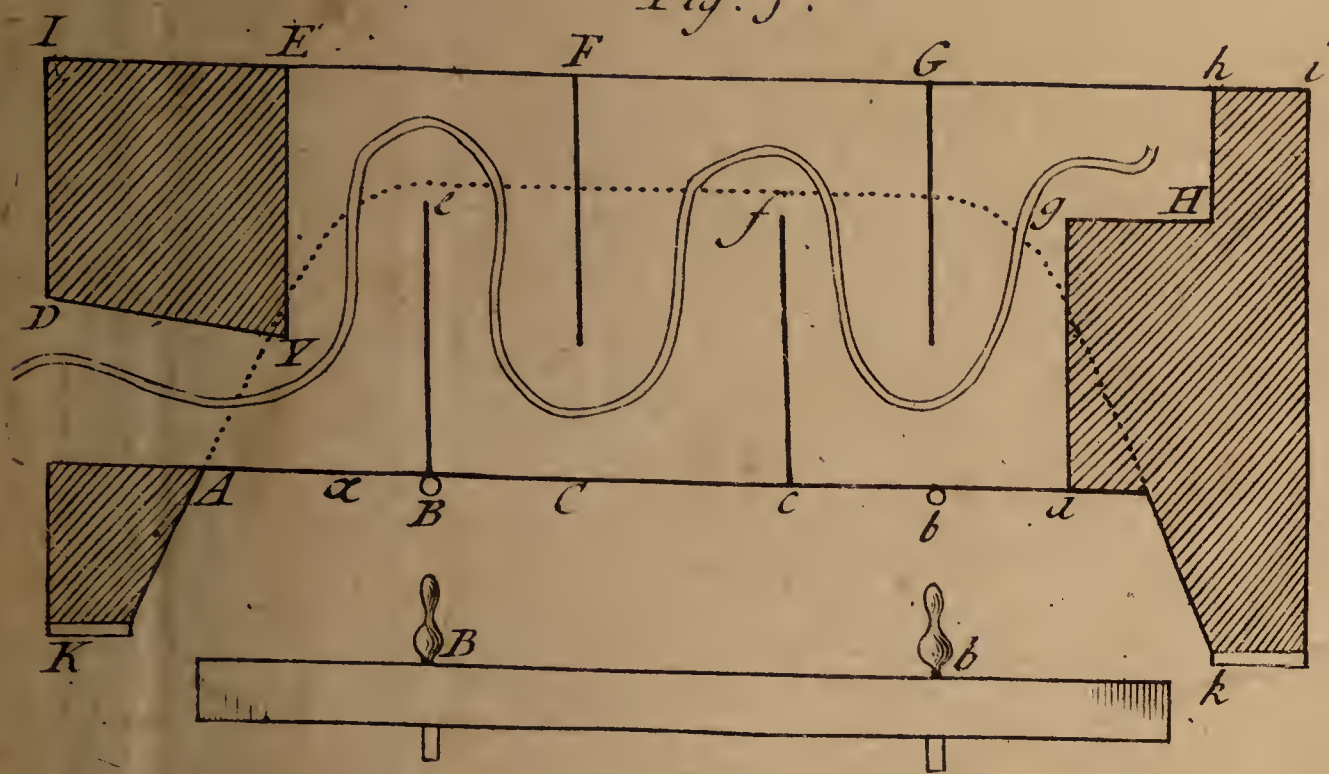


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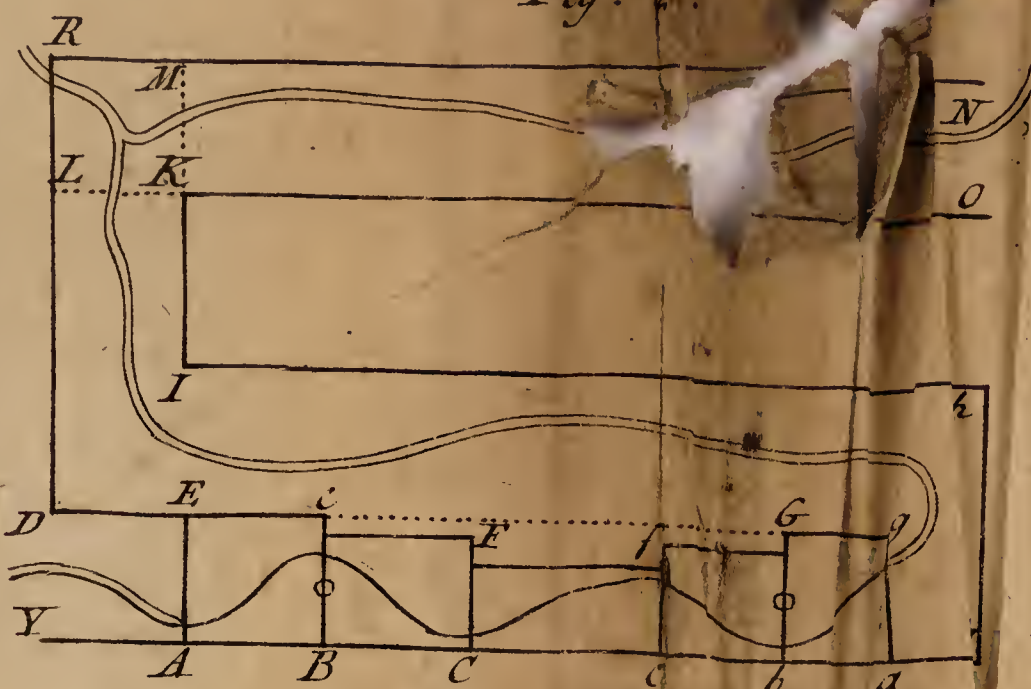


Fig. 6

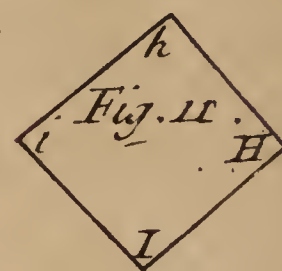
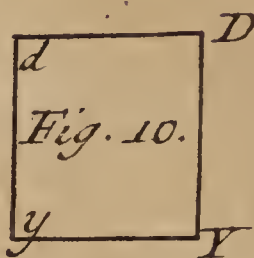
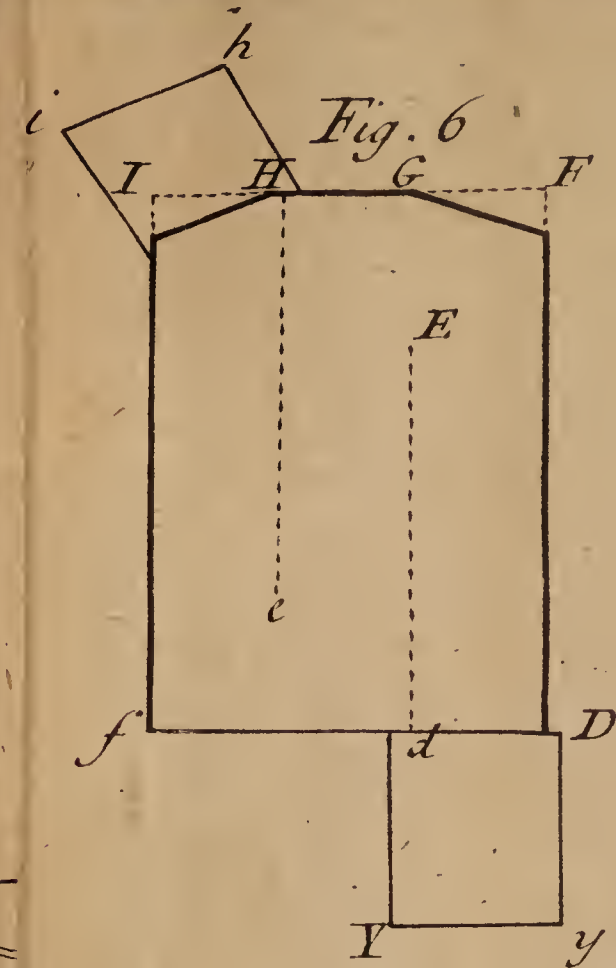


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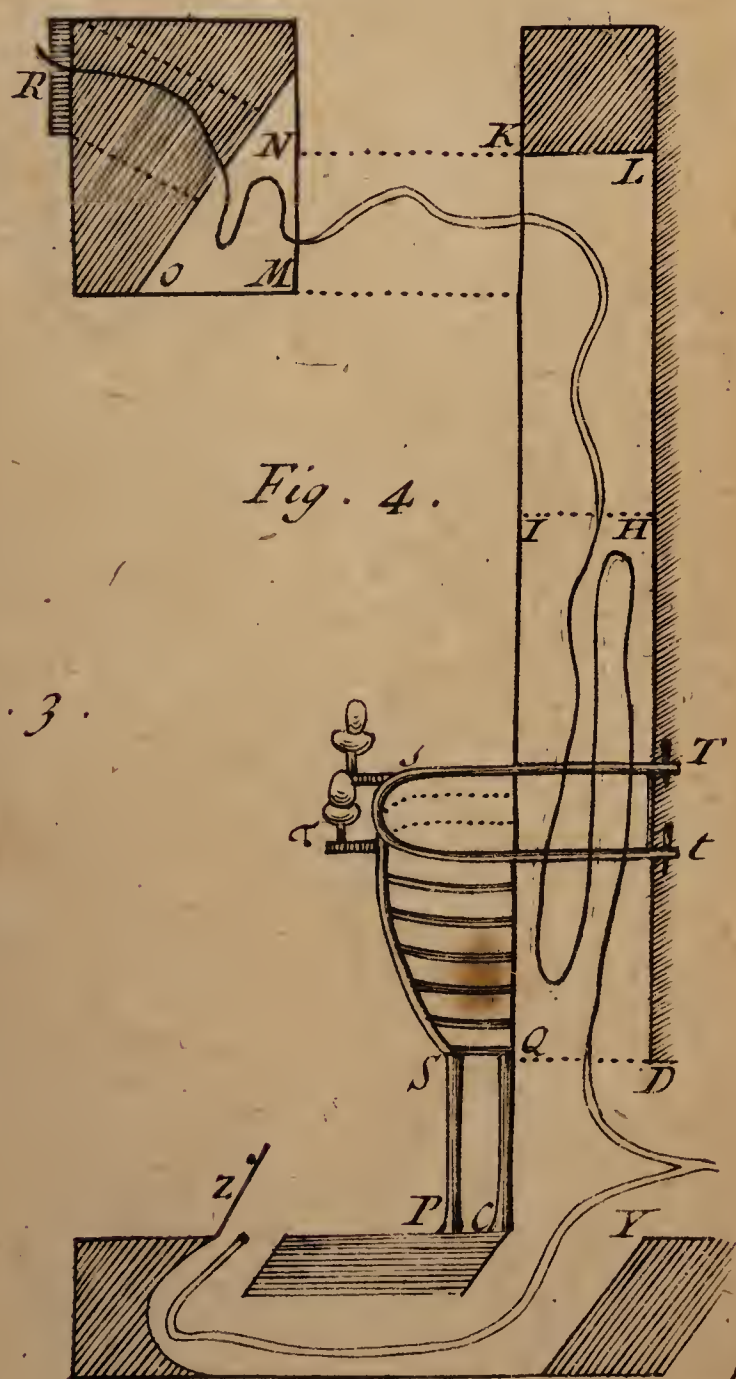


Fig. 3.

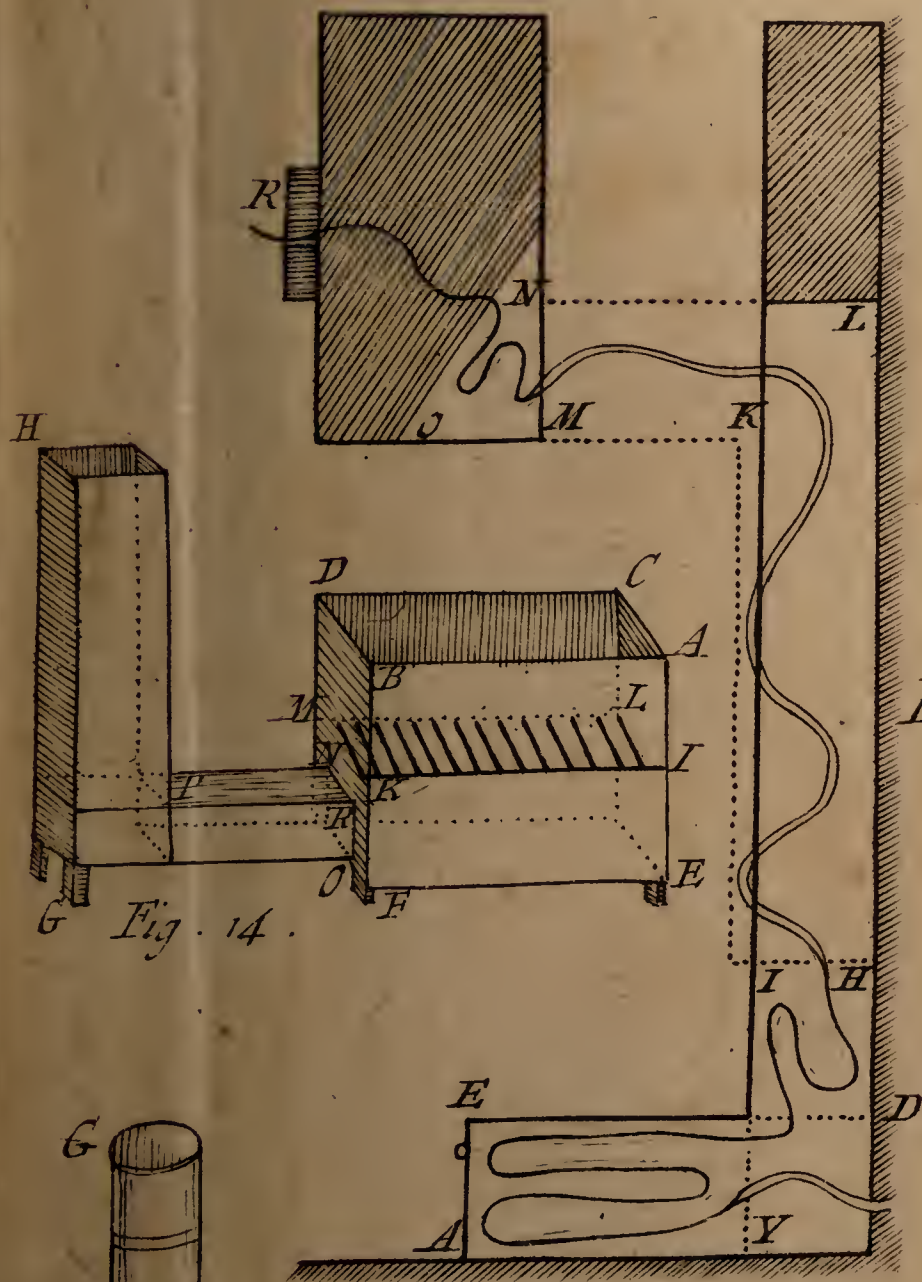


Fig. 14.

Fig. 13.

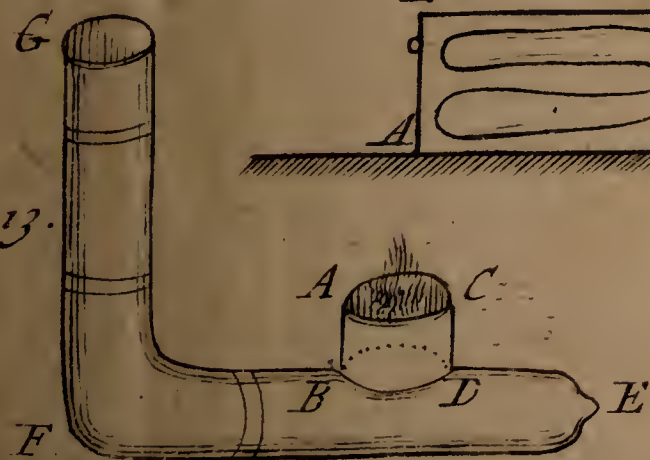


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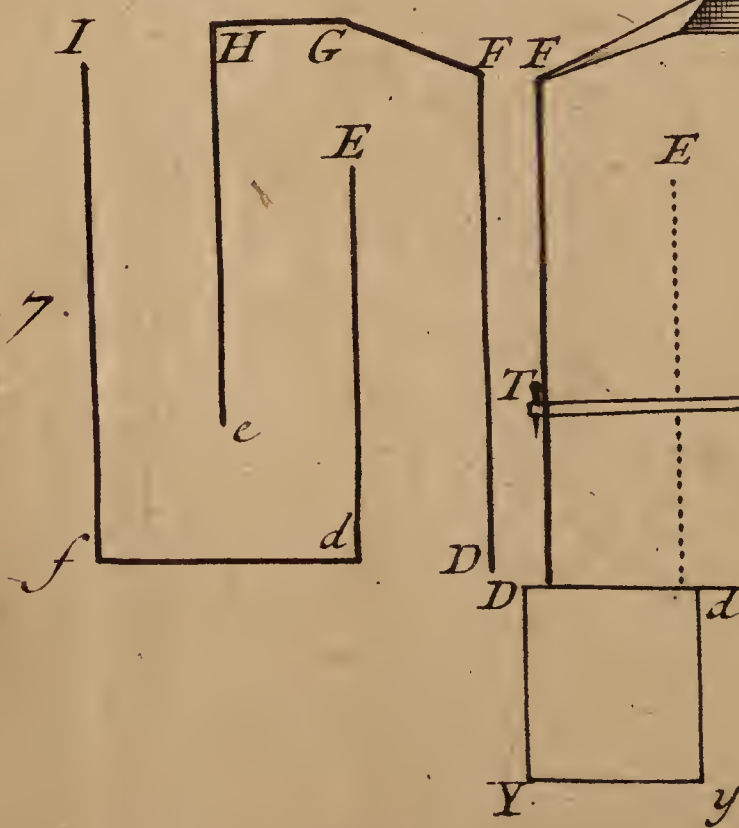


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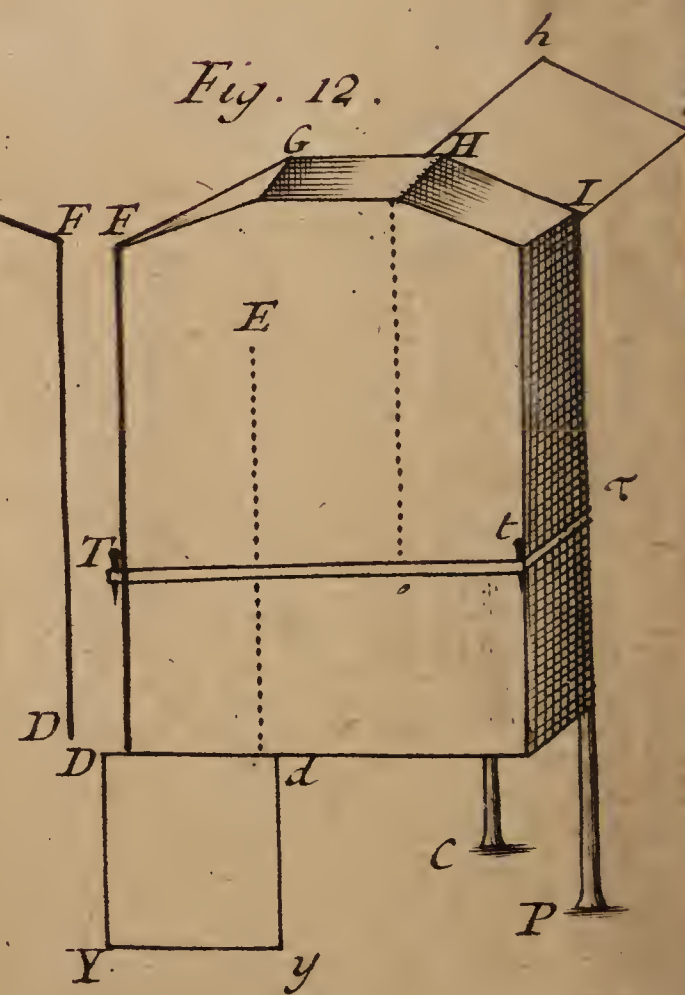
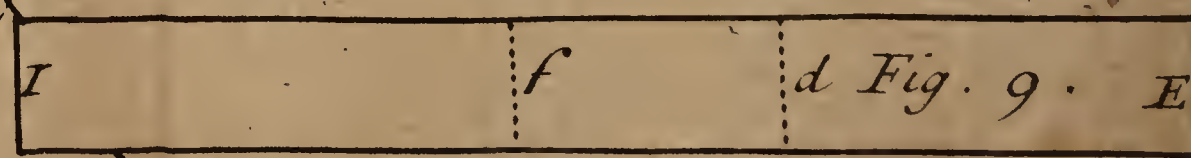
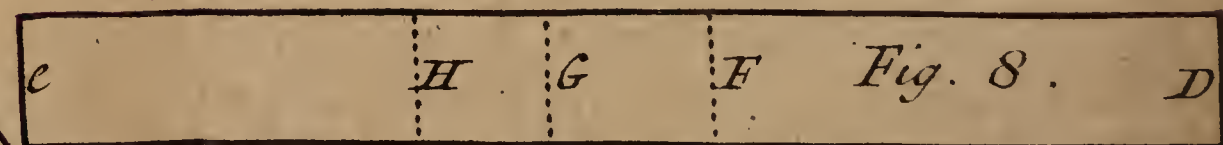
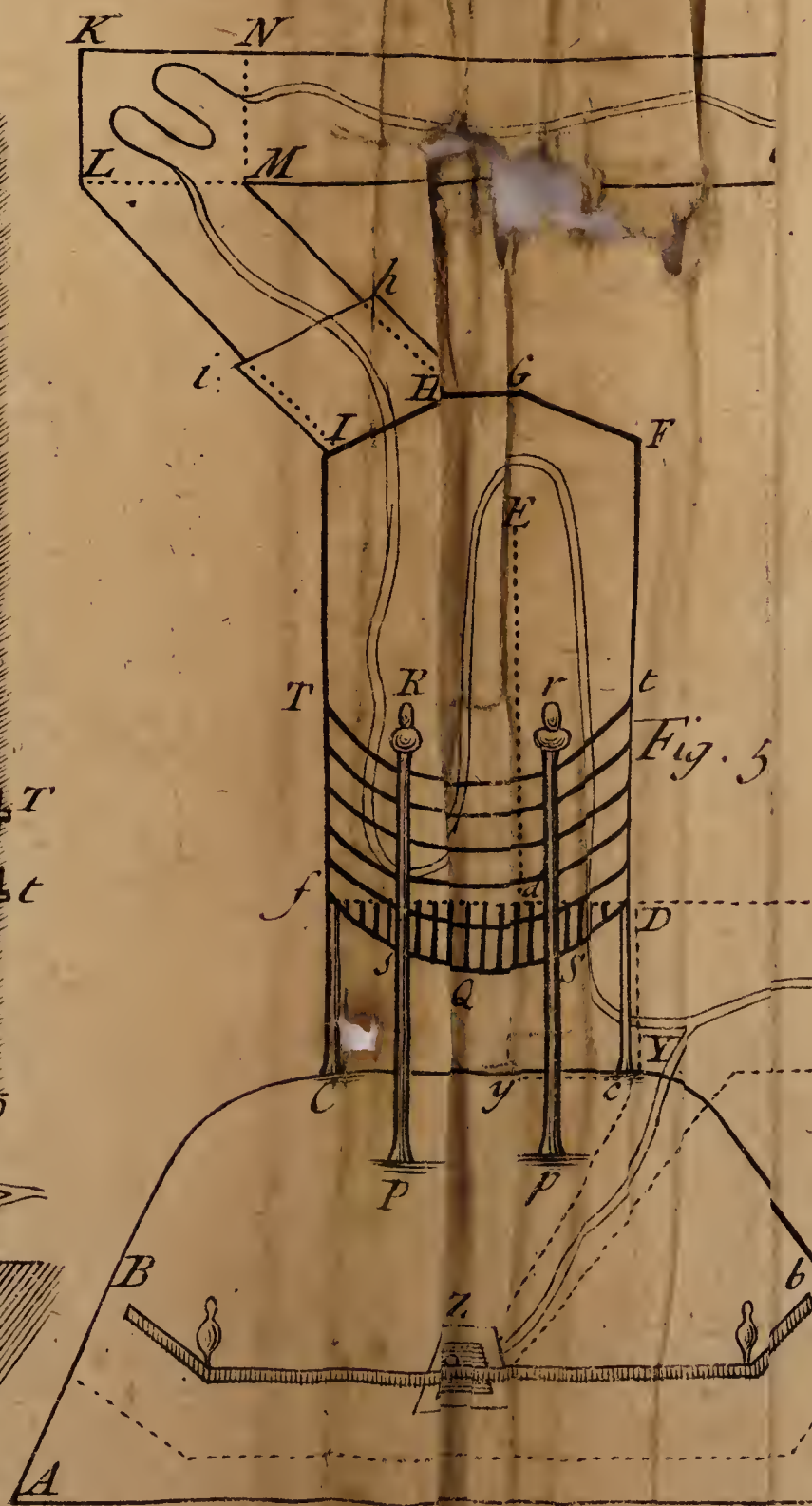


Fig. 5.



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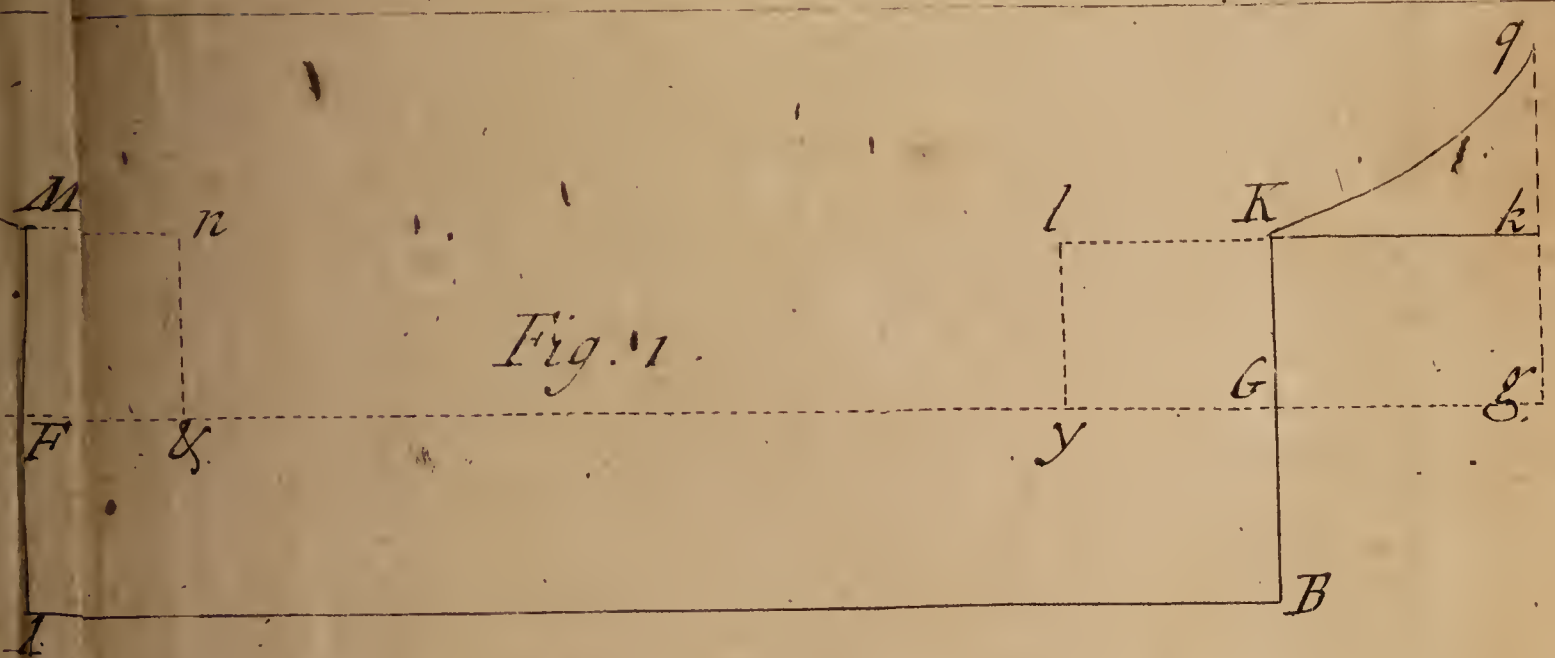


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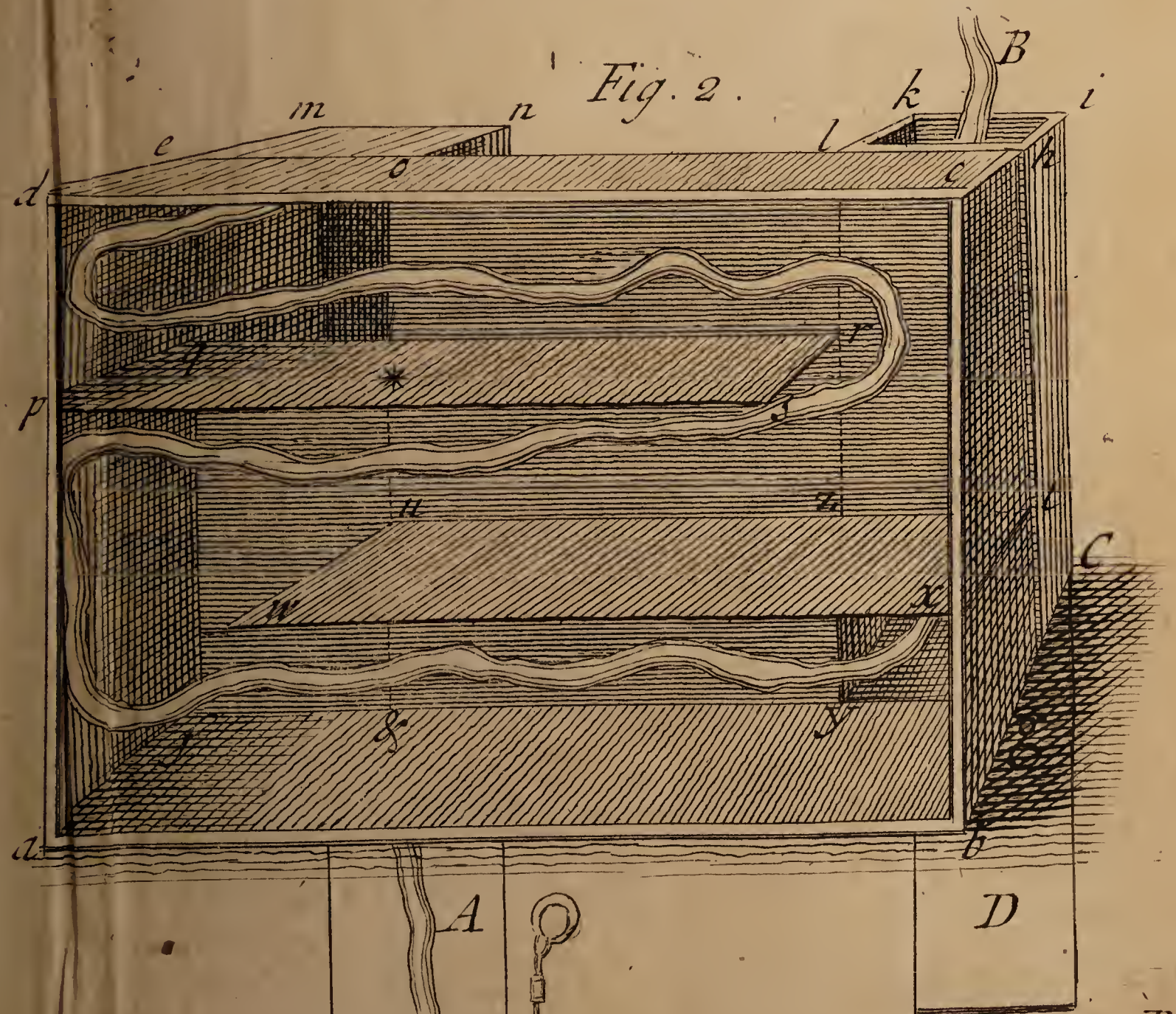


Fig. 2.

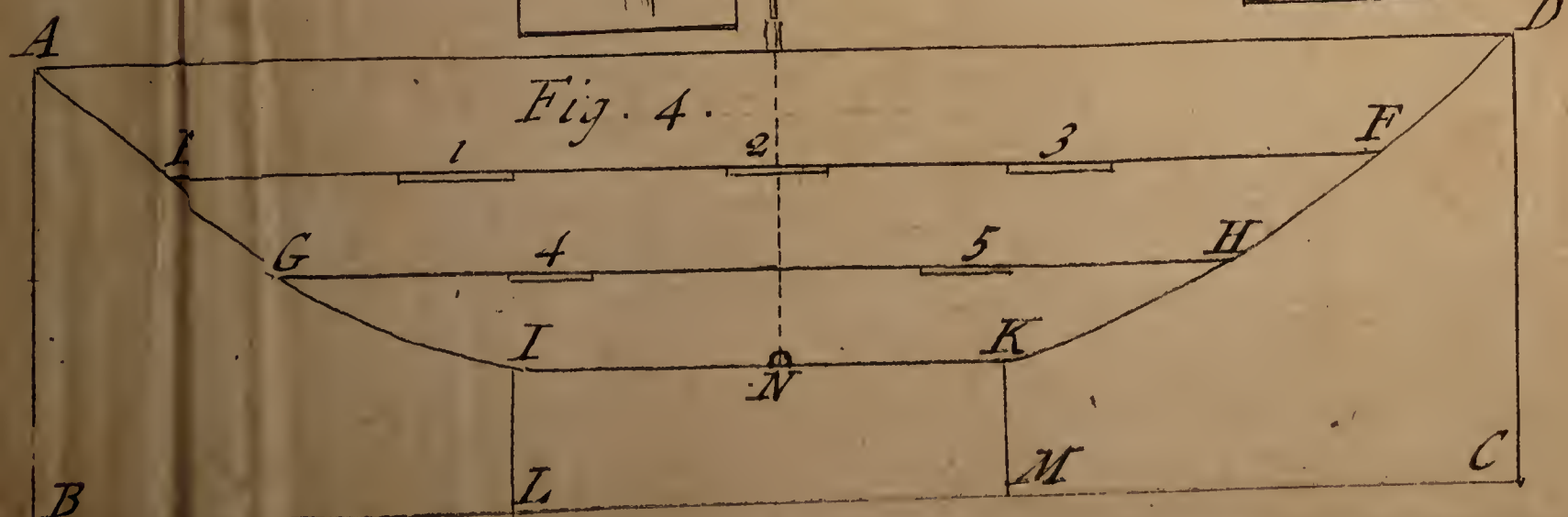


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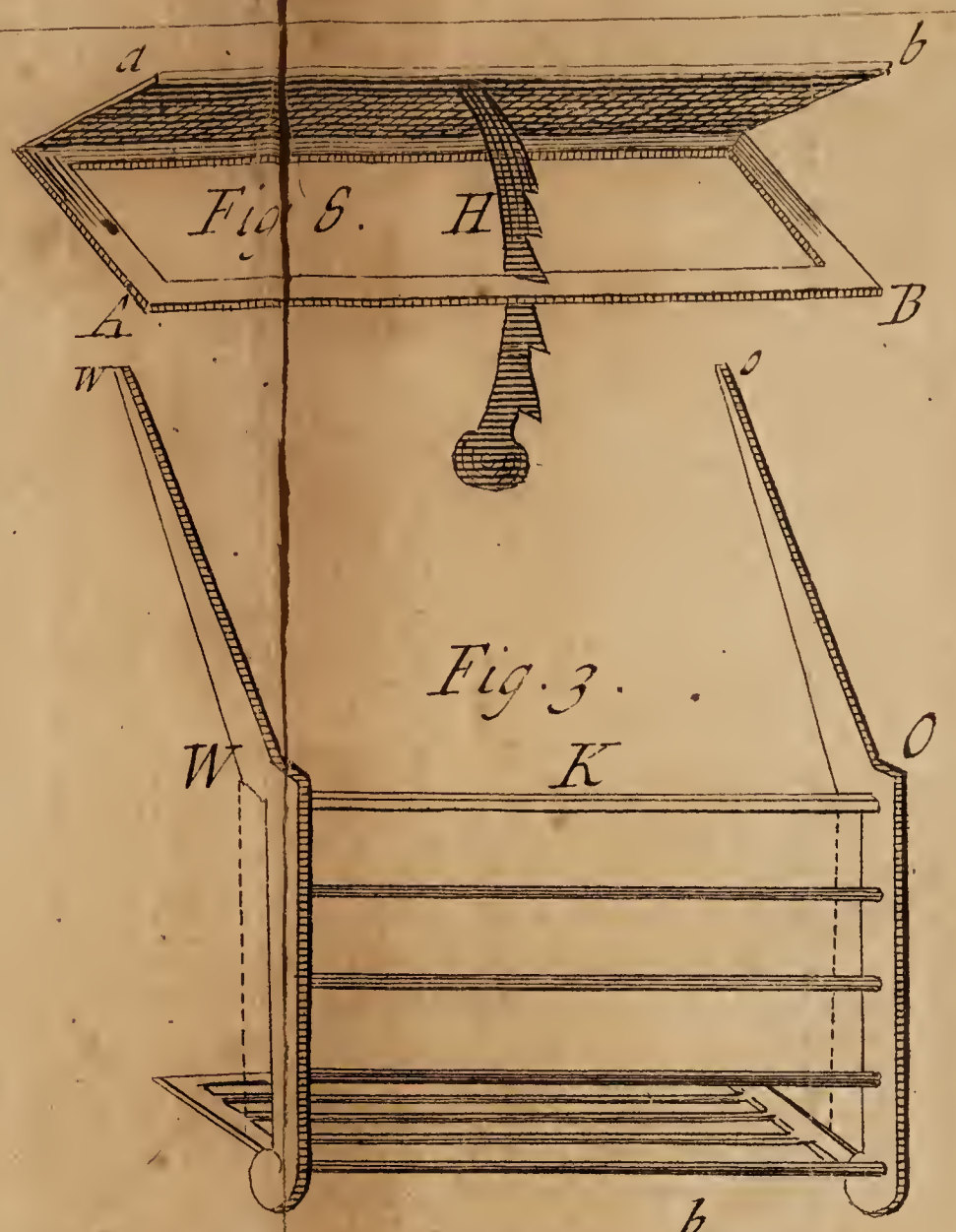


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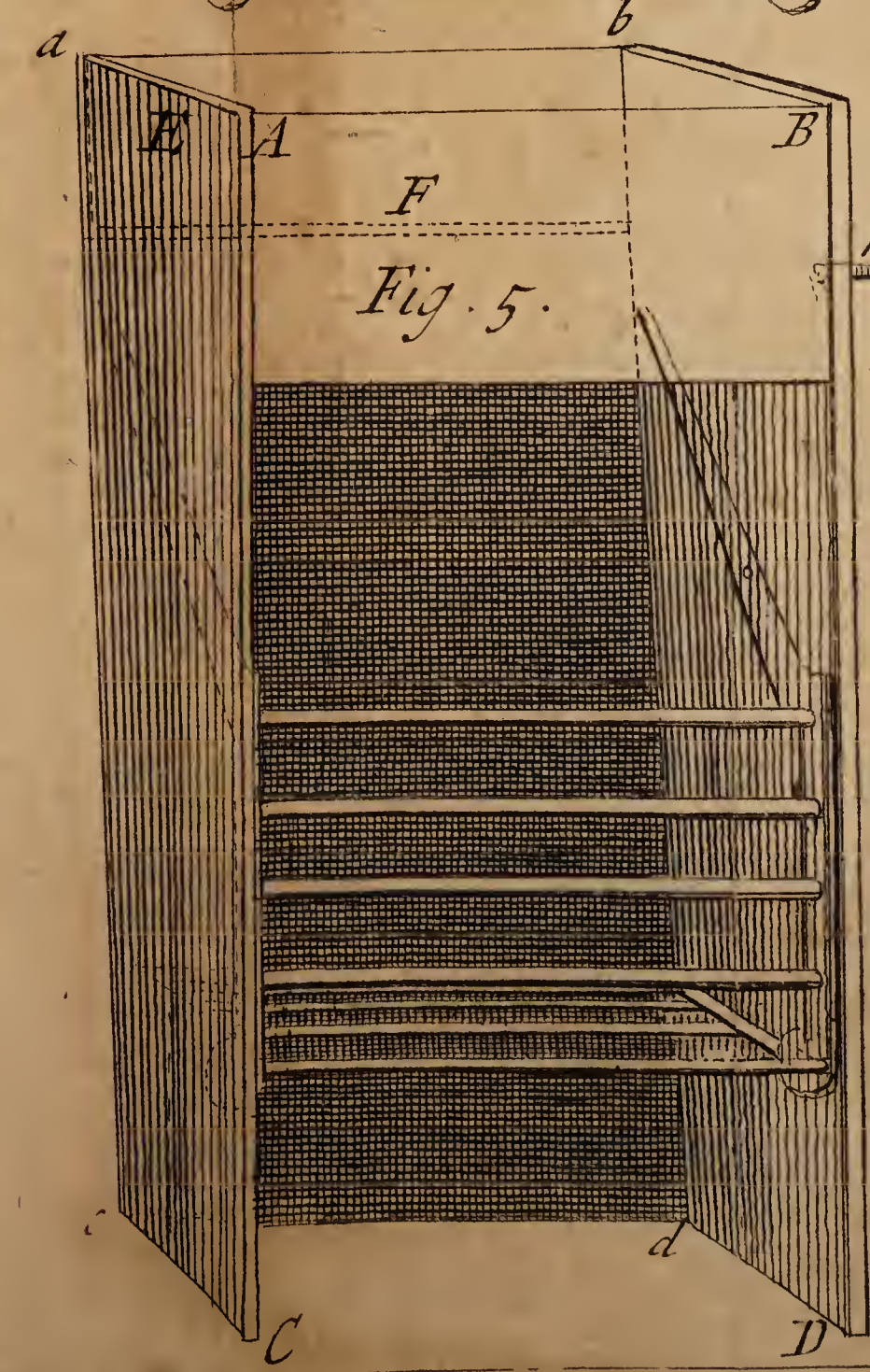


Fig. 5.

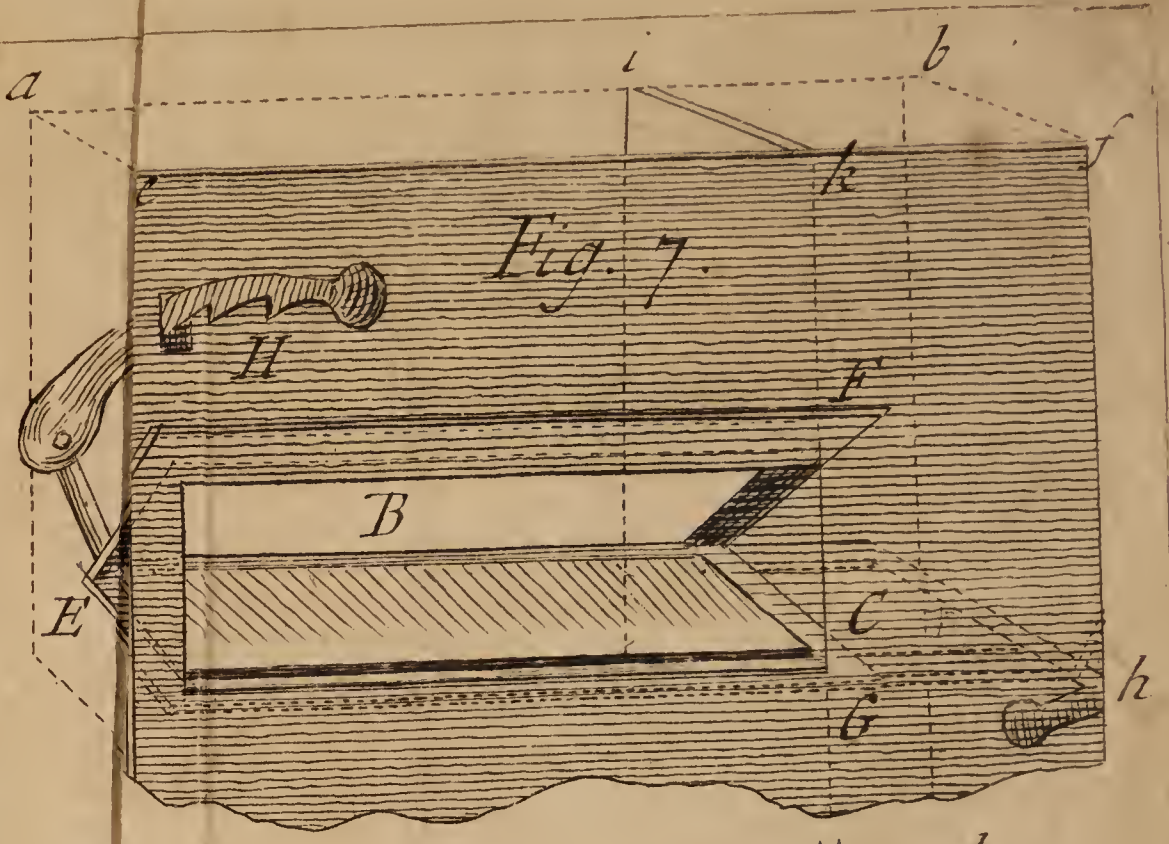


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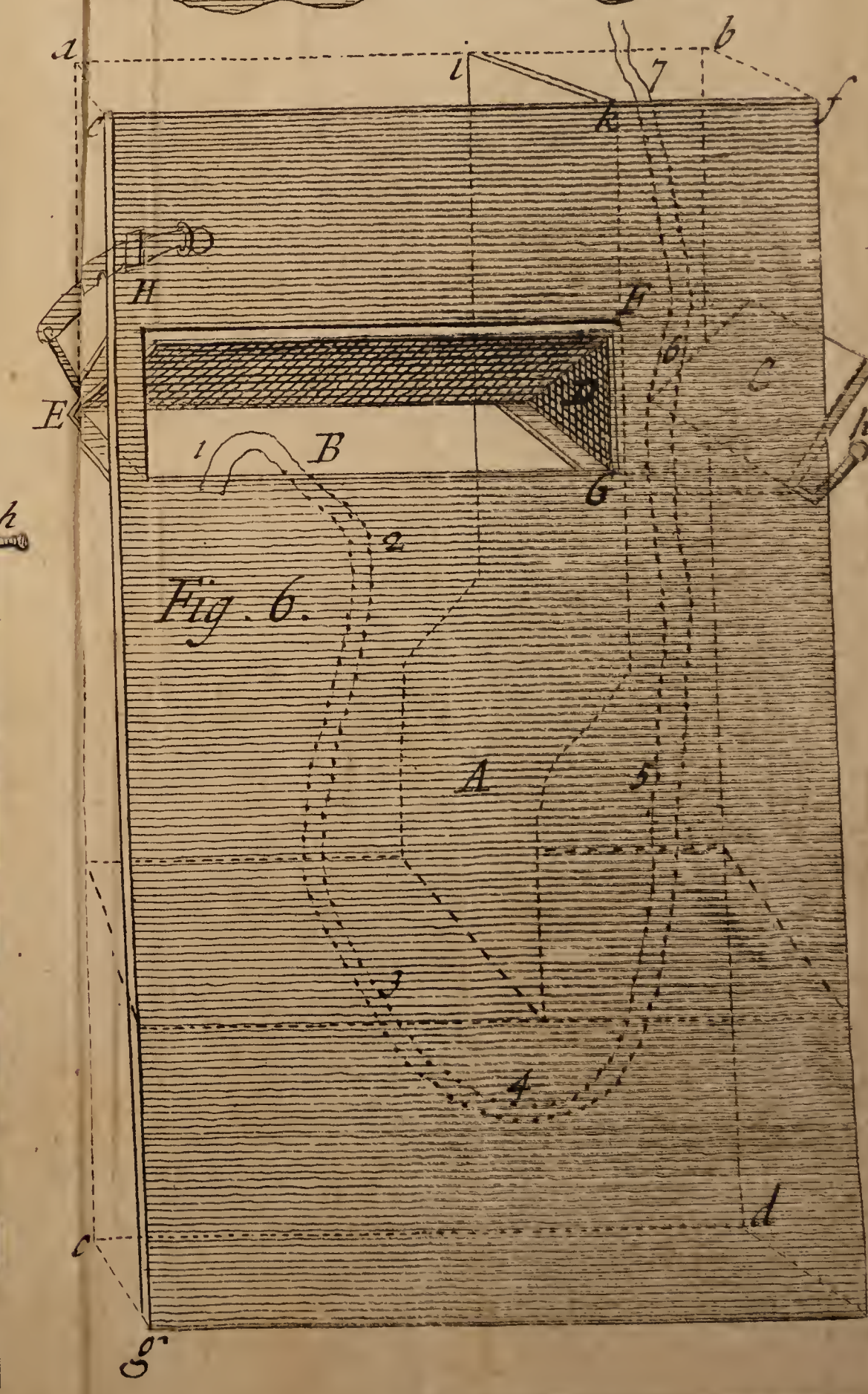


Fig. 6.

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